

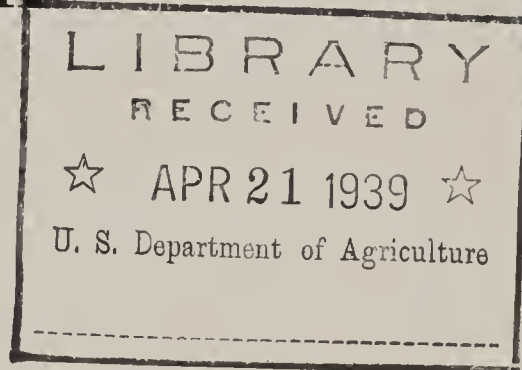
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THE FIRE-CONTROL EQUIPMENT Handbook

1938



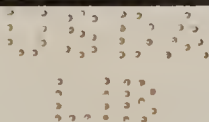
Compiled and currently maintained by the Forest Service through its committee on fire-control equipment and development and standardization, with material assistance afforded by other Federal, State, and private agencies, individuals, and equipment manufacturers and dealers

UNITED STATES DEPARTMENT OF AGRICULTURE
FOREST SERVICE

UNITED STATES GOVERNMENT PRINTING OFFICE

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UNITED STATES DEPARTMENT OF AGRICULTURE
FOREST SERVICE

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Fire
Equipment Handbook

Washington, D. C., November 1, 1938.

REGIONAL FORESTERS AND EXPERIMENT STATIONS:

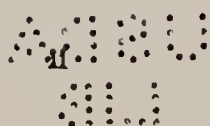
This handbook of fire-control equipment and the associated master specification file should be of direct use to fire-control technicians and managers, both within and outside the Forest Service.

This manuscript was prepared in 1937. It therefore does not contain certain recent developments.

It is highly desirable that the handbook and the master specification file be kept up to date by systematic revisions. The process of periodic revision should be so managed as to lend all possible encouragement to further improvements and invention in the fire-control equipment field.

These purposes will be served by the following pages of instructions (Foreword) which are hereby approved, effective immediately.

C. M. GRANGER,
Assistant Chief, Forest Service.



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FOREWORD

FOREWORD

The purpose of this handbook is to provide a medium for the general dissemination of information on the various types and kinds of equipment, standard and otherwise, used in connection with forest fire-control work. It will also serve as a catalog for the master specification file.

The master specification file provides a source from which may be obtained detailed specifications covering many items of fire-control equipment which are described and illustrated in the handbook. The availability of these specifications is considered to be of major importance. It will facilitate standardization, where that is desirable, reduce the difficulties encountered in purchasing fire-control equipment, and promote better understanding among manufacturers, dealers, and purchasing agents, all of which will result in a material saving in time and expense.

While standard specifications for many items of fire-control equipment have been adopted, it should be emphasized that this should not lessen the urge for experimentation and new development. It is hoped that the handbook and master specification file will serve as a stimulus to a more orderly and rapid development program, and that the dissemination of information thus acquired will prove of benefit to all fire-control agencies.

Handbook Distribution.

This handbook bound in loose-leaf binders has been distributed to all regional foresters, forest supervisors, district rangers, and other members of the Forest Service who have use for it. Other Federal, State, and private forest fire-protective agencies, forest schools, equipment manufacturers, and dealers, or anyone else desiring to obtain copies of the handbook may do so by purchasing them direct from the Superintendent of Documents, Washington, D. C. These stocked copies will be delivered unbound, but punched to fit standard commercial binders.

The standard binder (produced by Master-Craft and by Remington-Rand) which will be used by the Forest Service can be had practically anywhere:

Post binders (four-post type).
Holds sheets 8 by 10½ inches.
Capacity: ¾ inch expanding to 1¼ inches.

Arrangement of the Handbook.

The handbook is divided for convenience into three parts, as follows:

Part One—Fire-Control Equipment.—This part contains both general and descriptive information relative to standard items of fire-control equipment and other items which have been developed and tested to a point sufficient to insure a certain measure of practicability and usefulness.

Part Two—Fire-Danger Measuring Equipment.—Included in this part is general and detailed information relative to the various items of equipment and other devices which have been developed for measuring fire danger (weather, fuel conditions, etc.). This is a wide open field; therefore, the users of this handbook who have anything to contribute along this line should do so promptly so that it may be included in the first amendments.

Part Three—Miscellaneous Information.—This part embodies various techniques, routines, and devices pertaining to the construction, maintenance, use, and care of fire-control equipment. There is much worth-while material for this section of the handbook which has not yet been submitted. Users of the handbook are requested to send in their contributions for consideration.

The Master Specification File.

A master file, containing detailed specifications for all fire-control equipment for which index numbers appear in the handbook, is maintained at the Supply Depot. Specifications from this file are available to all Federal, State, and private forest-protective agencies; and to anyone else having legitimate use for them. Agencies outside the Federal Government will not be charged for specifications.

Federal Government agencies will obtain specifications direct from the Supply Depot, submitting standard requisitions. All others desiring specifications will obtain them through the local regional forester's office. When requisitioning specifications, be sure to give both *name of item* and *index number* of the specification wanted.

The specification numbering index is bound in the back of this handbook. When the letters MSF appear as a prefix to the master file index number of an item, it signifies that the specification for the type of article described has been adopted as standard for the Forest Service. Where the letter S is affixed to the index number it denotes that the entire specification for the particular item concerned is contained in the handbook write-up. When such a reference mark as *R1-X*, *R3-X*, or *R7-X* appears in lieu of an index number, it

signifies that requests for more detailed information or specifications should be submitted direct to the regional forester of the Region indicated by the central number. In cases involving outside agencies, the name and address will appear.

A reasonable stock of prints of each specification will be maintained at the Supply Depot in order that requisitions may be filled without delay. Each regional forester's office may carry on hand a supply of the specifications contained within the master file if desired. However, this supply should not be excessive since it can be replenished at any time from the Supply Depot. If stocks are held close to actual needs, there should be little loss when revisions are made.

Individual Regions are not authorized to reproduce master file specifications, since it obviously cannot be done as economically as at the Supply Depot, where plates have been prepared which are good for many hundreds of prints.

A nominal charge will be made for specification prints requisitioned by Regions. The schedule of prices for letter-size (8 by 10½ inches) prints is given below. The prices quoted apply to individual sheets and not to individual specifications unless contained upon a single sheet. The detailed specifications for some items cover several pages. In a few cases it was found impracticable to reduce specification drawings to letter size which would permit plate printing. Charges for copies of these specifications will be made on an actual cost basis. There are so few items of this class and the sizes vary so much that it is impracticable to quote prices.

Schedule of Prices

Printed sheets:	<i>Cost per print Cents</i>
1 to 50 -----	4
51 to 100 -----	3½
101 to 200 -----	3
201 to 300 -----	2½
301 to 500 -----	2¼
Over 500 -----	2

The total number of printed sheets ordered at one time governs the price per sheet for the lot. Thus the order may consist of prints of any number of different specifications.

As previously indicated, specifications included within the master file have been given index numbers. Where a number is comprised of two parts, the second applies to either an integral part of the whole article concerned or another article of close similarity.

Amendment and Additions.

Amendments and additions to the handbook ordinarily will not be issued more often than once each year or less often than once every 2 years. If agencies, organizations, or individuals who have purchased handbooks from the

Superintendent of Documents desire future amendments and will so notify the Chief, Division of Fire Control, Forest Service, Washington, D. C., they will be advised when amendments are available for purchase from the Superintendent of Documents.

Amendments and additions to the master file will be made at like intervals, except in cases where it may be necessary to amend specifications between regular amendment periods. This will be one of the responsibilities of the equipment committee members as explained hereinafter under the heading, Duties and Responsibilities of Each Regional Committee Member.

Agencies outside the Forest Service are requested to submit additional material for the handbook or specifications for the master file, together with any recommendations for amendments to either, to the Supply Officer, Forest Service, Government Island, Oakland, Calif., or to the local regional forester. Contributions may be submitted at any time and they will be filed for consideration by the equipment committee at its next meeting.

The fire-control equipment committee requests that each outside agency do its utmost in contributing to the perpetuation and usefulness of both the handbook and the master file. Many worth-while contributions have already been received from outside sources and it is hoped the good work will continue. Rather than perform local censorship on the possible value of datum, send it in and allow the committee to pass judgment as to its value for general distribution.

In order that data may be properly submitted, the following information is offered:

Handbook Data.—The general descriptive write-up should contain a brief but comprehensive description of the item or process, stating its range of usefulness and limitations. In case of home-made items, the material used and method of construction should be clearly outlined. Photographs should be submitted for all except the most common of equipment items. Six prints of each photograph, or preferably one print and the negative, should be submitted. Unnecessary or inappropriate backgrounds should be avoided.

Specifications.—Where specifications are prepared for the master file they should be drawn and lettered to a scale so that the individual sheets can be reduced to 8 by 10½ inches (letter size) and still be clear and legible. Specifications which have already been drafted may be submitted as they are and, if necessary, the committee will have them redrawn. Specifications should be complete in every detail. Six copies of each should be submitted.

Revisions.—Recommendations for revision should in every case be accompanied by com-

plete supporting data, clearly setting forth all circumstances surrounding the case. If a substitution is recommended, submit detailed specifications of the new item proposed. Submit six copies of all data concerned.

All Forest Service data should be submitted through the local regional office, where they will be given preliminary review by the regional committee member. Regional data may be submitted to the Supply Depot currently, or annually with the fire-control equipment report. Data pertaining to individual equipment items should be submitted on separate sheets to facilitate handling and filing.

Each Region will submit to the Supply Depot annually, by January 2, a fire-control equipment report which will contain the following data:

1. Itemized list of amendment, addition, and revision material submitted during the calendar year, including any additional data accompanying the report.

2. A comprehensive progress report upon each equipment betterment or development project assigned to or voluntarily undertaken by the Region. Include projects conducted by experiment stations, cooperative projects with outside agencies, and projects of merit handled entirely by outside agencies.

3. A list of equipment betterment and development projects which the Region feels are worthy of attention during the coming year. The projects should be described as fully as possible in order of importance.

4. A list of experimental development and betterment projects which can be carried to early completion by the Region and for which it is willing to accept assigned responsibility.

5. Comments, criticisms, and suggestions toward increasing the usefulness and efficiency of the Fire-Control Equipment Handbook, the master specification file, and the functions of the equipment committee. Bear in mind that opportune development, betterment, and standardization of fire-control equipment is the established objective.

Permanent Fire-Control Equipment Committee.

Henceforth there will be a permanent fire-control equipment committee, which shall be comprised as follows:

One member from each of the Forest Service Regions, except the Alaska Region, which membership is optional with the regional forester, the supply officer, who will serve as the permanent secretary, and the Chief of the Washington Division of Fire Control, who will act as permanent chairman. Each regional member will be designated by the regional forester and will serve until transfer of station or change of duty assignment necessitates a replacement. Each regional forester will be responsible for notifying the committee chair-

man as to who will be the regional committee member and also of subsequent changes at the time they are made.

The functions, duties, and responsibilities of individual committee members, Regions, other agencies, and the committee (when assembled) are as follows:

Duties and Responsibilities of the Committee Chairman.

1. Responsible for Service-wide development of fire-control equipment and service rendered to all fire-control agencies by means of the Fire-Control Equipment Handbook and master specifications.

2. Serves as active chairman at all committee meetings.

3. Establishes the beginning date and approximate duration of committee meetings.

4. May request attendance of any regional member or other specially qualified person at any committee meeting.

5. Represents the committee in seeking any needed approval of and action on transactions of the committee by officers of the Forest Service in the Chief's office.

Duties and Responsibilities of the Permanent Secretary.

1. Responsible for maintaining the master specification file.

2. Responsible for rendering prompt service to Forest Service Regions and all other fire-control agencies desiring copies of master specifications or information regarding such specifications.

3. Reviews all incoming material for completeness and carries on any necessary correspondence relative thereto with sending agencies or committee members.

4. Assembles, correlates, and otherwise prepares as completely as possible all material to be acted upon by the assembled committee.

5. Serves as clearinghouse and information bureau between Regions, committee members, and outside agencies.

Duties and Responsibilities of Each Regional Committee Member.

1. Responsible for overseeing the preparation of the regional amendment, addition, and revision contributions.

2. Corresponds directly with and obtains the viewpoints of other committee members in accordance with the procedure outlined in case his Region feels the need for an immediate revision of any standard specification or a substitution therefor. If agreement is reached among a majority of the members, the completed case should be forwarded to the chairman for final review and approval. Upon approval, the case will be forwarded to the secretary with instructions to revise the master specification file accordingly.

3. Responsible for overseeing and reporting upon regional equipment betterment and development projects and assignments, including cooperative and private developments.

4. Handles all regional correspondence related to the subjects or projects involved.

5. With the approval of the regional forester, attends all committee meetings.

6. Will be duly authorized and fully prepared to speak for his Region and to vote upon any subject requiring such action. Such votes as he may cast will be considered as regional choice.

7. Gives assistance as requested by the chairman or secretary, in reviewing data submitted by other departments or outside agencies, in carrying on related correspondence, etc.

8. Corresponds with other regional committee members and outside agencies to the extent necessary to keep posted currently as to progress and new developments elsewhere, and to inform them of local developments.

Duties and Responsibilities of Each Forest Service Region.

1. Committee members from all Regions, except Region 10, will attend all regular meetings unless authority to the contrary is received from Washington.

2. Any Region called upon will arrange for its regularly appointed member to attend any special meeting called by the chairman.

3. Each Region will definitely make provision for the necessary time and financial assistance in order that the work may be carried on as intended and the regional committee member be permitted to fulfill his responsibilities.

Agencies Outside the Forest Service.

1. Agencies outside the Forest Service are invited to send representatives to committee meetings. Those desiring to send representatives should inform the chairman or the secretary of their wishes in sufficient time for him to notify them of meeting dates.

2. As previously stated, outside agencies are requested to submit handbook and master file material for consideration by the committee.

3. Outside agencies are encouraged to correspond freely with, or contact regional representatives, the secretary, or the chairman regarding any phase of the work.

Duties and Responsibilities of the Committee (Assembled).

1. Regular assembled committee meetings will be held at the Supply Depot or elsewhere in January, annually or biannually, as may be necessary.

2. A voting quorum shall be comprised of not less than four regional representatives, one of whom shall be from an eastern Region, and the chairman.

3. Ordinarily no special report of the minutes of a meeting will be prepared, since it is intended that handbook and master file amendments and regional equipment development assignment correspondence will contain such information as would be included in a general report.

4. Committee will review all new equipment specifications submitted, adopt specifications as standard for Service-wide use, or for inclusion in the master file as nonstandard specifications, and amend the file and the handbook accordingly.

5. Committee will review all specification revision recommendations submitted and for those accepted shall take the necessary action to revise master file specifications and amend the handbook accordingly.

6. Committee will review all amendment data and additional general material submitted for the handbook, selecting therefrom and preparing in final form for printing such data as are to be included.

7. Unless and until disapproved by the Chief's office, decisions made and standards adopted by the required voting quorum of the committee will be binding upon all Regions regardless of membership representation.

8. Committee will act as a clearinghouse for progress reports and recommendations and information on fire-control equipment experimental, betterment, and development projects. The committee will also consider regional recommendations and will be responsible for making specific development project assignments to individual Regions.

9. The committee must give careful consideration in an open-minded manner, to all equipment-betterment recommendations submitted. The adoption of various items as standard does not obviate the need for betterment in many cases, nor the necessity for considering the possibilities in any case.

10. If found to be necessary, the committee will elect one of its members to assist the secretary in the final preparation of the handbook amendment data, specification revisions, and new specifications after all duties of the assembled committee have been performed.

Forest Service Purchases.

The use of standard specifications from the master file by all divisions of the Forest Service is mandatory when making purchases of equipment items for which standard specifications have been prepared (items marked MSF). This does not preclude purchases for strictly experimental purposes under specifications deviating from the standard specifications.

The purchasing of certain items of equipment will be restricted to specifically designated Regions, the Supply Depot, or the Washington Office. These are items which for the

most part logically should be purchased in this manner for obvious reasons, the principal of which are (1) to facilitate compliance with specifications and inspecting and testing of items furnished; (2) to interest larger and more responsible manufacturers and to obtain lower quotations by making quantity purchases; (3) to facilitate and encourage experimental development work on the part of manufacturers; (4) to preclude provincialism and to promote Service-wide interest and benefits; (5) as a matter of service and convenience to all Regions. This last reason specifically applies to stock items carried by the Supply Depot, which may be requisitioned currently.

The following index scheme has been used to designate the items and to denote the central purchasing agency responsible for supplying Service needs:

WO-P—Purchases to be made by the Washington Office.

SDO-P—Purchases to be made by the Supply Depot.

R1-P, R6-P, etc.—Purchases to be made by one Region. The Region responsible is designated by the central number in the index.

Purchasing of items designated as indicated above by the individual Regions or units, will, of course, be permissible in legitimate fire emergencies.

Equipment Development Work.

Each Region will be expected to carry on its proportionate share of equipment development

work, and to fulfill such direct assignments as may be made by the committee, to the fullest extent possible with the facilities available.

Other agencies are requested to cooperate by notifying the committee chairman, secretary, or local member of contemplated projects, and to submit progress and summary reports of work undertaken by them as it progresses or is completed. Information concerning equipment development projects undertaken or proposed by the Forest Service will be furnished upon request to the chairman, secretary, or to any committee member. Agencies desiring to carry on cooperative projects should contact local Forest Service officials, or the local regional committee member.

Fire Control Notes.

The Forest Service publication Fire Control Notes is the official organ in which will be published currently any article submitted containing general progress reports, recommendations, or personal viewpoints concerning items or subjects which may eventually furnish handbook and master file material, but which have not as yet reached a stage of development or acceptance warranting their use in that manner. Fire Control Notes should be considered as an open forum, and handbook users are encouraged to make full use of it in this manner, as in many other ways. Agencies outside the Forest Service are especially encouraged to submit their data and viewpoints for dissemination. Mail such data direct to: Division of Fire Control, Forest Service, Washington, D. C.

PART ONE
FIRE-CONTROL EQUIPMENT
SECTION A
DETECTION EQUIPMENT

PART ONE

FIRE-CONTROL EQUIPMENT

SECTION A

DETECTION EQUIPMENT

Eighteen-Inch Plain-Base Alidade. (Index No. MSF-2-1. SDO-P.)

A plain-base brass alidade having a 10-inch rear sight with two 4- by $\frac{1}{64}$ -inch apertures, and a $5\frac{1}{2}$ -inch front sight with 4-inch opening containing sight hair. This type of alidade is for use with the plain type of lookout map board (see index No. 49), or with a map sketching board.

Twelve-Inch Plain-Base Alidade. (Index No. MSF-2-2. SDO-P.)

This alidade is the same as the 18-inch plain-base alidade described except for the sights. The rear sight is $6\frac{3}{4}$ inches high with two $2\frac{3}{4}$ -by $\frac{1}{64}$ -inch apertures and with $2\frac{3}{4}$ -inch opening containing sight hair.

Pivot-Type Alidade. (Index No. MSF-1. SDO-P.)

A special alidade designed for use with the wood fire finder or with a plain lookout map board (fig. A-1). It is approximately 18 inches in length with a 10-inch rear sight having two 4- by $\frac{1}{64}$ -inch apertures and a $5\frac{1}{2}$ -inch front

sight with $4\frac{1}{4}$ -inch opening and sight hair. There is a pivot pin provided which is approximately 12 inches from the front end of the alidade. This pin is fitted to a $\frac{1}{8}$ -inch brass plate upon which the alidade revolves when placed upon the map board or fire finder. To mount the alidade, the brass plate is centered upon the map board or fire finder over the exact lookout point and held in place by two brass screws. A $\frac{3}{16}$ -inch hole is then drilled through the map board to accommodate the pivot pin. The left-hand side of the base of the alidade is cut away on the line of sight from the pivot pin to the front sight, forming a straightedge which is graduated for scaling distances up to 22 miles on a $\frac{1}{2}$ -inch scale map.

When used with the wood fire finder (index No. 131), the pivot pin may be removed and the threaded hole in the alidade reamed to fit the pin, which is cemented into the fire finder. If a watertight joint is necessary. If the pivot pin joint does not have to be watertight, the regular pin in the fire finder can be removed and the alidade used in the usual manner without the brass plate. If a more sturdy mount-



FIGURE A-1.—Pivot-type alidade.

ing is desired, the brass plate may be mounted beneath the glass top by countersinking into the map board.

Vertical-Angle Alidade. (Index No. 3. California Forest and Range Experiment Station-X.)

A simple, inexpensive instrument for measuring vertical angles from lookouts equipped with Bosworth or other fire finders without vertical-angle attachments.

Consists of a felt-bottomed iron bracket carrying a movable sighting arm and a vertical pendulum. The sighting arm carries peep sight, horizontal front sight, and photographic print of scale with $1/2^\circ$ graduations. The pen-



FIGURE A-2.—Vertical-angle alidade.

dulum is suspended on the same axis as the sighting arm. It carries an index pointer and a lead weight on lower end to increase stability and reduce frictional errors. The instrument is accurate within approximately $1/4^\circ$ plus or minus. The base need not be leveled to function accurately. Over-all height $9\frac{1}{2}$ inches; length of sighting arm 13 inches. Figure A-2 shows a side view of the instrument.

Wood Lookout Map Board. (Index No. 49.)

A plain wood map or drawing board provided with rabbeted hardwood end strips and a softwood center inlay. Size of the board is 20 by 28 inches. The hardwood end pieces and the softwood inlay are for the purpose of preventing warping and splitting when exposed to the weather. This board may be manufactured by any good carpenter by following the specifications carefully.

Lookout Map Baseboard (Koch Board). (Index No. 51.)

The lookout map baseboard, or Koch board, is simply a plain wooden baseboard upon which

is provided an orienting arm against which the lookout map board can be placed for orienting purposes. The orienting arm works back and forth in a slot for the purpose of orienting the lookout board. The orienting arm is held permanently in place when once oriented by means of a bolt which passes through the outer end of the arm, a slot in the baseboard, and is secured by a wing nut on the bottom side thereof.

Like the lookout map board, the baseboard can be manufactured by any carpenter by referring to the specification.

Wood Type Fire Finder. (Index No. 131.)

Designed for use where funds are not available for the more expensive metal fire finder, or under conditions where the cost of a precision instrument is not considered justified.

Consists of a well-made board $23\frac{1}{2}$ inches square, with solid frame arranged for mounting on a stand. A map with full azimuth circle thereon is mounted on the board and covered with plate glass. A pivot-type alidade (index No. MSF-1) is used for sighting. The glass and board are drilled at center to receive pivot pin. Specification includes canvas case for protecting fire finder when not in use.

The main purpose of the glass is to afford complete protection to the map from moisture when the instrument is mounted in exposed locations. After the glass is placed over the map the edges can be sealed thereto with glue, varnish, shellac or other suitable material, and plastic wood or cement can be used between the pivot pin and the glass to form a waterproof seal. With this arrangement, the pivot pin and plate furnished with the pivot-type alidade is not used, the threaded hole in the alidade being reamed to fit the pin furnished with the fire finder.

Osborne Fire Finder. (Index No. MSF-130. R6-P.)

An instrument designed for use by lookouts in determining location and size of fires discovered (fig. A-3). It can easily be set up, oriented, adjusted, and used by unskilled men, following simple directions. The instrument consists of:

1. A redwood baseboard with three parallel tracks for shifting center as necessary to dodge obstructions, without disturbing orientation.
2. A lower plate with grooves and leveling screws, machined to fit tracks, and center bearing for upper plate.
3. An upper plate which carries on its outer edge an engine-divided azimuth graduation of transit precision.
4. A sight ring which revolves around shoulder on upper plate and carries the sights, a 1-

minute vernier, and a guard to prevent erroneous readings. The rear sight has a scale and a peep slide for reading vertical angles from 3° plus to 20° minus. Stretched between the sights is a graduated steel tape for defining the line of sight and scaling the distance on the map. Horizontal angles can be read accurately to at least $2'$; vertical angles to $4'$.

5. A galvanized-iron map disk, $20\frac{5}{16}$ inches in diameter, held to upper plate by a center pin and six flat-headed screws. (See p. 3-13 as to preparation and mounting of map.)

6. A 4-inch, graduated, spirit level, sensitive to about $1'$ to one division, for leveling instrument. Shipping weight, 85 pounds.

The instrument may be mounted on a wood fire-finder stand or cabinet, constructed locally, or on an iron pedestal designed for the purpose (See index Nos. MSF-135 and 136.) Rigidity of mounting is essential.

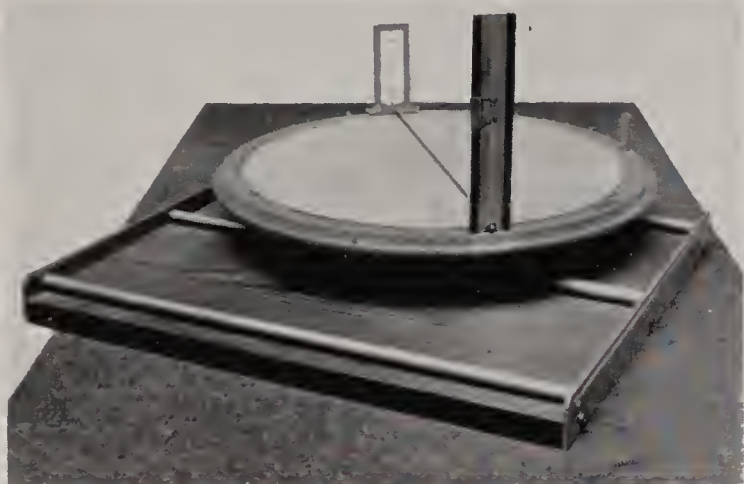


FIGURE A-3.—Osborne fire finder.

Fire-Finder Stand, Metal. (Index No. MSF-135.)

Consists of two identical castings for base and top, joined by a 3-inch pipe long-threaded at both ends to permit vertical adjustment of about 10 inches. After adjustment, pipe is fastened securely with two lock nuts having protruding pins so that the nuts can be tapped into place with a hammer, thus obviating the necessity for a large wrench. A $\frac{9}{16}$ -inch hole is drilled in the pipe so that it can be turned with a rod or screwdriver. This stand when securely fastened to floor of lookout house or tower cab is quite rigid and should prove satisfactory to those desiring a metal stand.

While this stand is particularly adapted to use with the Osborne fire finder, it can be used as a pedestal or base for other types of fire finders or plain lookout map boards by simply fastening a lookout map baseboard (see index No. 51), or other similar base, thereon with four screws or small bolts.

Fire-Finder Stand, Wood. (Index No. 136.)

A rigid stand in the form of a paneled cupboard, to be fastened securely to the floor of lookout house or tower cab with lag screws.

All pieces are joined with wood screws, no nails being used. With this type of construction the stand is not only absolutely rigid when new, but also it will remain rigid. Two shelves are provided in addition to floor space beneath the stand for storing forms and stationery, telephone batteries, and other articles. A recessed space is provided at one side for the telephone so that it will not protrude beyond the fire-finder baseboard. This is not absolutely necessary, because little if any inconvenience will be caused by omitting the recess and fastening the telephone to one of the side panels. Side space may also be used for hanging maps, telephone directory, etc. Size of model illustrated, 19 by 22 by 38 inches. In some locations it may be necessary to vary the height to permit taking all vertical angles. Where ready-cut houses are purchased, material for stand may be included.

This stand was designed primarily for use with the Osborne fire finder; however, it is equally well adapted for use with any sort of fire finder or map board.

Fire-Finder Map-board Table. (Index No. 132.)

An efficient but inexpensive and easily constructed map-board table designed and used by the Texas Forest Service. All material is No. 1 yellow pine with the exception of the $\frac{1}{4}$ -inch fir panel board on the sides and bottom of the box. However, other material could be substituted and white pine would be desirable on the top. The table is fastened together with nails and screws and has been found to be of sufficient rigidity for lookout work.

The dimensions of the table are approximately 3 by 3 feet at top and base, by 45 inches in height.

Lookout Map-board Light. (Index No. 231.)

The entire light arrangement is comprised of the required length of standard drop-light cord, an enameled shade or reflector 6 inches in diameter, white inside and dark green outside, and a switch socket using a 4.5-volt Mazda globe. The light can be operated with a standard "hotshot" battery or three No. 6 cell telephone batteries. Many rangers use discarded telephone batteries for this light.

The light is suspended directly over the lookout map board or fire finder where it can be switched on and off as needed for night detection duties, such as locating fires, recording lightning strikes, etc. The shade or reflector prevents the light from shining into the observer's eyes, directing it downward onto the map, instead.

Glare-Reducing Goggles. (Index No. MSF-155. SDO-P.)

Designed especially for use by lookout men to overcome eye strain. Frames are of noncorrosive metal, adjustable to individual require-

ments, and designed for comfort. Glasses are neutral tint, with transmission of visible radiation from 25 to 30 percent, and optically finished to eliminate all distortion. Investigation has shown that practically all cheap, colored goggles cause eye-strain because of imperfections in the glass used.¹

Binoculars. (Index No. MSF-41. SDO-P.)

Prismatic type, 6 by 30 power, meeting United States Navy specifications. For use by lookout men in distinguishing between true and false smokes, in confirming the presence or absence of smoke under suspicious circumstances, and in locating small smokes after lightning storms. Since study of the use of instruments of higher than 6 by 30 power indicates that they offer few advantages and many disadvantages, their use for fire-detection purposes is not desirable.

Binoculars may be equipped with mil scale at small additional cost, permitting the estimation of distances to and sizes of objects or fires.

Test-Smoke Bomb. (Index No. 59.)

Sometimes called "smoke candle" or "smoke pot." Designed to simulate as nearly as possible the smoke from a small forest fire (approximately 200 square feet in Douglas fir duff). Length, 7 inches; diameter, $1\frac{1}{2}$ inches. Emits smoke for a period of from 4 to 5 minutes. Smoke from a single bomb can be seen against a dark background 15 to 17 miles on the clearest days. Used as standard smoke in calibrating the Byram visibility meter (index No 456). It can be used to check efficiency of lookout men and in making visibility tests. However, it should be recognized that it does not duplicate a natural smoke under all conditions and convection currents to carry the smoke upward

¹MCARDLE, R. E., and BYRAM, G. M. GOGGLES FOR INCREASING THE EFFICIENCY OF FOREST FIRE LOOKOUTS. *Jour. Forestry* 34: 797-801, illus. 1936.

naturally are lacking. Experience in at least two Regions has shown that the bomb has a definite value for the purposes indicated, and it is very convenient to use. It is reasonably safe in dry weather, but should be wrapped in a wet sack or placed in a metal container at time of lighting as a special precaution. Ordinarily the bomb is lighted on the ground and held aloft on a long pole.

Figure A-4 illustrates the smoke volume created by a single candle. The smoke created is heavy and does not rise to any great height above the ground; therefore, the bombs have little practical value for use in heavy timber stands.

Alarm Clocks.

For use by lookouts (refer to sec. E, Camp equipment).

Protractors, Paper, Glassine, or Opaque.

Azimuth Circles (refer to sec. B, Compass, protractor, and dispatcher equipment).

Tower, Temporary, Steel. (R9-X.)

Region 9 is investigating and making use of a light-duty steel tower for both detection and visibility mapping purposes. The tower is supposed to be of a movable design so that it can be transported from one location to another. It is manufactured by the Aermotor Co., Chicago, and is available in several different heights. The approximate cost for a 40-foot tower f. o. b. Chicago is \$125, and the weight is 1,075 pounds. The 50-foot tower costs about \$160, and weighs 1,425 pounds.

Persons interested in this particular piece of equipment should obtain further detailed information from the Regional Forester, Milwaukee, Wis.

Tower, Crow's-Nest. (R9-X.)

Region 9 uses a single wood-mast type of crow's-nest for observation purposes in connection with fire-detection work. The crow's-nest consists of a single pole of the required size and length, which is guyed in place and upon which a small crow's-nest, or observation basket, is constructed. Spikes (or a climbing ladder) are then fixed to permit the lookout to mount the pole.

Refer to the Regional Forester, Milwaukee, Wis., for specifications or further detailed information regarding this particular item.



FIGURE A-4.—Smoke from test bomb.

SECTION B

COMPASS, PROTRACTOR, AND DISPATCHER EQUIPMENT

SECTION B

COMPASS, PROTRACTOR, AND DISPATCHER EQUIPMENT

Compass, Box Pocket. (Index No. MSF-100. SDO-P.)

A standard box pocket compass for use by smoke chasers and others in finding fires (fig. B-1). Case is aluminium, black finish, size



FIGURE B-1.—Standard box pocket compass and the shovel-handle attachment.

3 $\frac{1}{4}$ by 3 by $\frac{5}{8}$ inches, has white sighting line on inside of lid, and also a folding front hair sight for use with notch in lid fastening when it is desired to use shovel-handle attachment (see index No. MSF-16) or to rest compass in some other manner. Underside of case has brass socket threaded for shovel-handle attachment. Ring is graduated anticlockwise from 0° to 360° and provision is made for setting off variation to 30° either east or west.

Attachment for Box Pocket Compass. (Index No. MSF-16. SDO-P.)

A simple, inexpensive device to permit the use of a long-handled shovel as a Jacob's staff. It has a screw connection to fit the bushing provided in the base of the standard box compass. A triple-spring clamp fits over the end of the shovel handle which permits the compass to be leveled, within reasonable limits, in the same manner as a ball-and-socket joint.

Dispatcher Map Board, Metal.

For use in platting fire locations from fire finder azimuth readings reported to district rangers' headquarters, or to the supervisor's headquarters, or other central point. Consists of a $\frac{1}{2}$ -inch-scale base map or other suitable map mounted on a perfectly flat sheet of 14-gage, galvanized iron, which is screwed to a wooden backing or to the dispatcher or other

table top. If desirable to use two maps, the two metal sheets may be fastened to opposite sides of a board, pivoted in a frame to permit easy rotation. Directions as to preparation and mounting of maps on metal are given on page 3-13. The next three items describe triangulating devices which may be used with this board.

Dispatcher Protractor, Metal. (Index No. 268-1. R6-P.)

A half-circle protractor with 9-inch radius designed for use with metal dispatcher board (fig. B-2). Made of 16-gage half-hard brass, brushed and lacquered finish. Parallel azimuth graduations from 0 to 180 and 180 to 360. Straightedge graduated in miles for use with $\frac{1}{2}$ -inch and $\frac{1}{4}$ -inch maps. Full directions for use, as well as all graduations, are etched on the top of protractor and filled with black. Centering pin, made of No. 28 drill rod, is permanently fixed and protrudes one-eighth of an inch to engage in corresponding centering holes drilled in dispatcher map board.

Where necessary to project the line of sight beyond the radius of the protractor, a rule or straightedge may be used as illustrated.

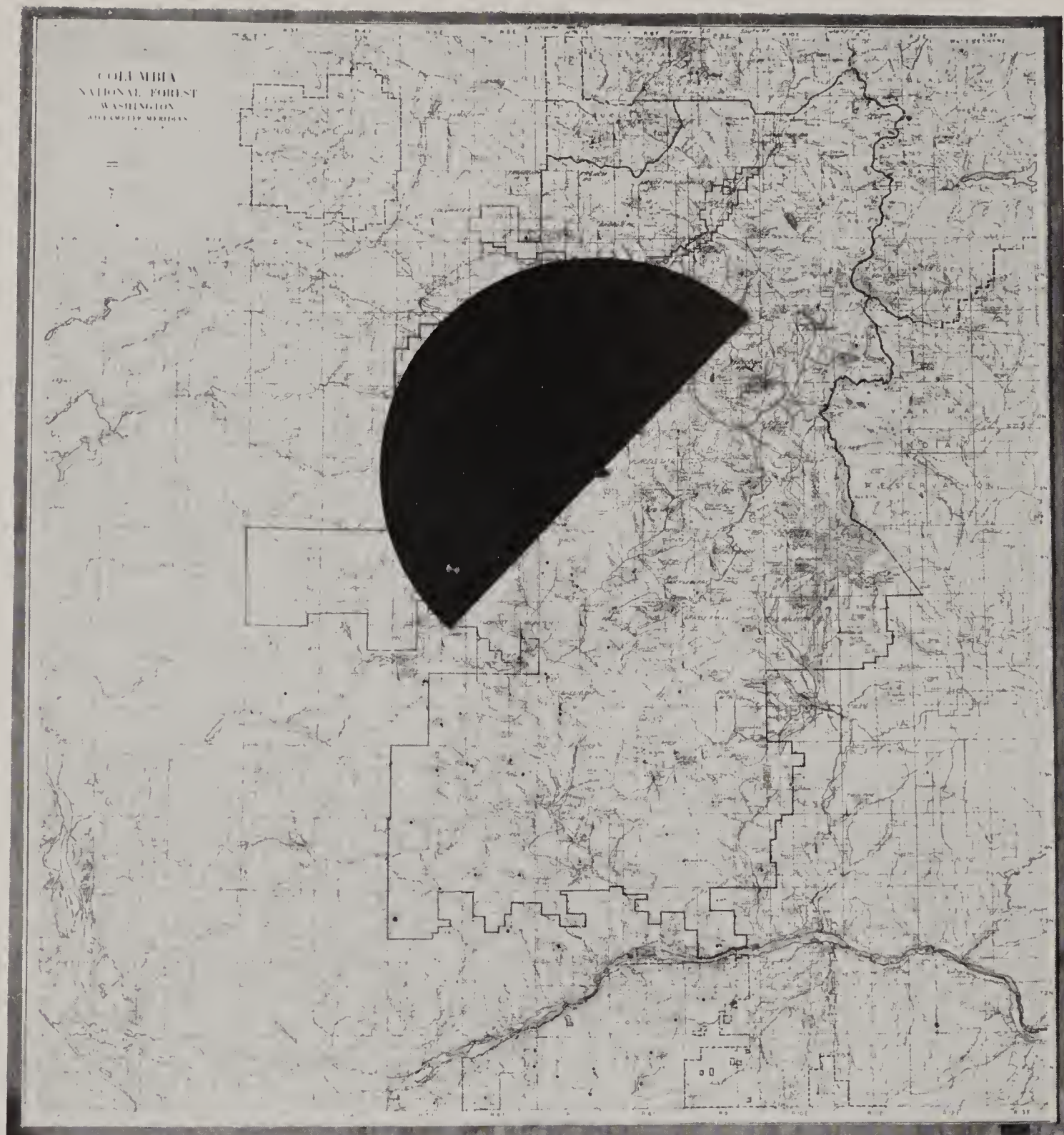
Dispatcher's Protractor, Transparent. (Index No. MSF-268-2. SDO-P.)

A full 360° protractor, 10 inches in diameter with an extension finger or straightedge which projects the zero line of the protractor to a total distance of 8 inches, or 16 miles on a $\frac{1}{2}$ -inch-scale map (fig. B-3). The zero line is slotted, approximately one-tenth of an inch wide, from the outer edge of protractor almost to the center pin to permit the use of a pencil along the entire line of sight. The protractor is graduated anticlockwise in order to permit turning off direct readings from a meridian line established for any given point upon the map.

The protractor is made of heavy, transparent material which does not obscure any part of the map when in use. A $\frac{1}{16}$ -inch centering hole is provided so that instrument can be used upon a smooth-surfaced map or with a centering pin.

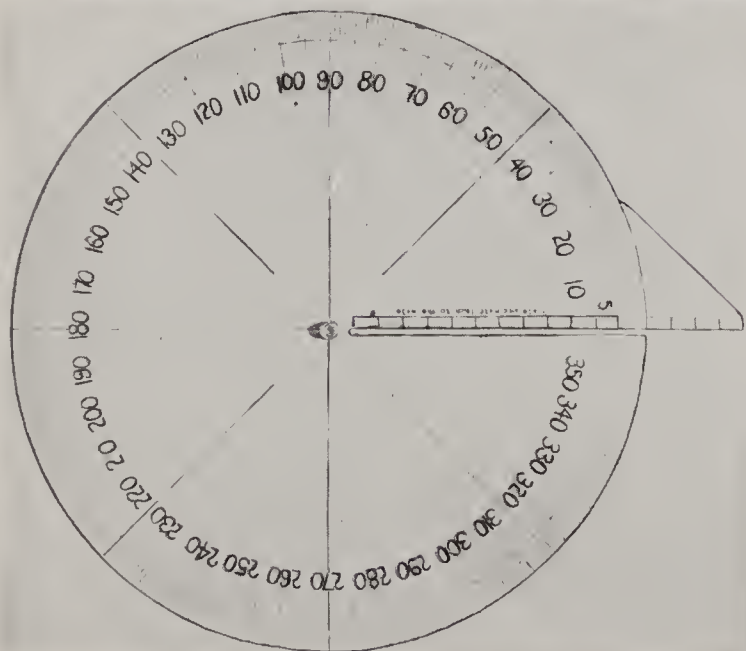
Dispatcher's Transparent Parallel Triangulator. (Index No. MSF-377. SDO-P.)

A device constructed on the order of a parallel rule, having 1 $\frac{1}{2}$ - by 16-inch blades and $\frac{1}{2}$ - by 8-inch separating arms. In using it for triangulating purposes, it is necessary to have only one azimuth circle upon the map to turn off any reading for any given point. If the



Above. FIGURE B-2.—Metal dispatcher board and protractor.

Left. FIGURE B-3.—Dispatcher's transparent protractor.



point from which a given reading is to be plotted is outside the reach of the triangulator, the line of sight can be stepped across the map from the master azimuth circle to the point concerned by simply holding one blade firmly in place and closing in or extending out the other, as the case may be, and repeating the process until the point involved in the reading is reached.

The instrument is made of heavy, transparent, fireproof material which does not warp readily; it does not obscure any portion of the map while in use. Each blade is provided with an offset in order to permit plotting readings close in to the azimuth circle center or on a nearly direct line therewith. The edges of the

blades are milled true for use as sighting lines or plotting edges. In addition there are sighting or centering lines etched the length of each blade. Several $\frac{1}{16}$ -inch holes are provided along the edges and sighting lines of one blade to engage the azimuth circle centering pin, if one is to be used. A pin is unnecessary although it facilitates the use of the triangulator and lessens the chance for error in centering over the azimuth circle.

Glassine Protractors. (SDO-P.)

The Forest Service Supply Depot, Oakland, Calif., carries in stock, available to Forest Service units, protractors printed by the Government Printing Office on transparent glassine stock. Two types are available:

(a) Five inches in diameter, full azimuth circle, with 1° divisions and marked every 10° . Carries directions for correctly mounting on a map.

(b) Three circles on the same sheet, 8 inches, 16 inches, and 24 inches in diameter. Each circle is divided into degrees, with each degree subdivided into $\frac{1}{4}^\circ$, and marked every 10° , in both azimuths and quadrants. The common center of the circles is marked by the crossing of the north and south and the east and west lines.

Retracting-String Reel. (Index No. MSF-296. SDO-P.)

A device to eliminate the necessity and inconvenience of many dangling strings on dispatcher and lookout map boards equipped with glassine protractors. The device consists of a spring-winding reel in which is provided a good grade of braided silk cord. A mounting bracket and a tube to conduct the string through a mounted map are also provided. Figure B-4 shows a side view of the reel mounted on the back of a $\frac{1}{4}$ -inch map board. For convenience, a Moore push pin may be fastened to the end of the string.



FIGURE B-4. Retracting string reel.

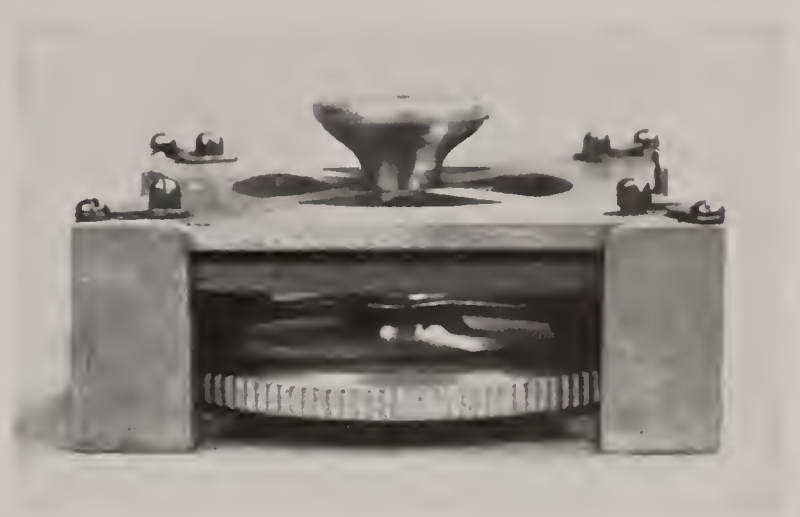


FIGURE B-5.—Azimuth circle printer.

Azimuth Circle Printer. (California Forest and Range Experiment Station—P.)

Designed for quickly and easily printing azimuth circles on dispatcher and other maps (fig. B-5). Over all dimensions, $6\frac{1}{4}$ by $6\frac{1}{4}$ by $3\frac{1}{4}$ inches; diameter of printed circle, $4\frac{3}{4}$ inches. The printer has two parts—the printing unit and the inking unit.

The printing unit consists of a square, flat, bronze base, with center removed. On two sides of the base are orientation markers corresponding to the positions of the 0° and 180° azimuths. The printing plate is suspended in a frame at the four corners of the base and is normally held above the lower surface of the base by four springs at the suspension points. The frame holding the printing plate has a handle in the center, and suspended from this handle is a sliding pointer to permit accurate centering of the circle. When the instrument has been oriented and centered, an even pressure on the handle forces the plate to the map surface and makes the impression.

The inking device consists of a frame which supports the printing unit and a rotating ink ring and spider with three gelatin ink rollers. The Masonite ink ring is supported by a knurled plate mounted on the support frame through a self-aligning ball bearing. The ink-roller spider is mounted on a pin at the center of the upper face of the knurled plate. The rollers evenly ink the printing plate as the plate is depressed against them and the knurled inking plate is rotated.

Accessory items necessary for successful operation of the printer include gasoline and cleaning cloths, a brush for cleaning the type, a spatula, and a small piece of glass on which to mix the printer's ink and cobalt dryer.

The California Forest and Range Experiment Station will arrange for the manufacture of these instruments for Forest Service units and cooperating agencies at a cost of approximately \$25.

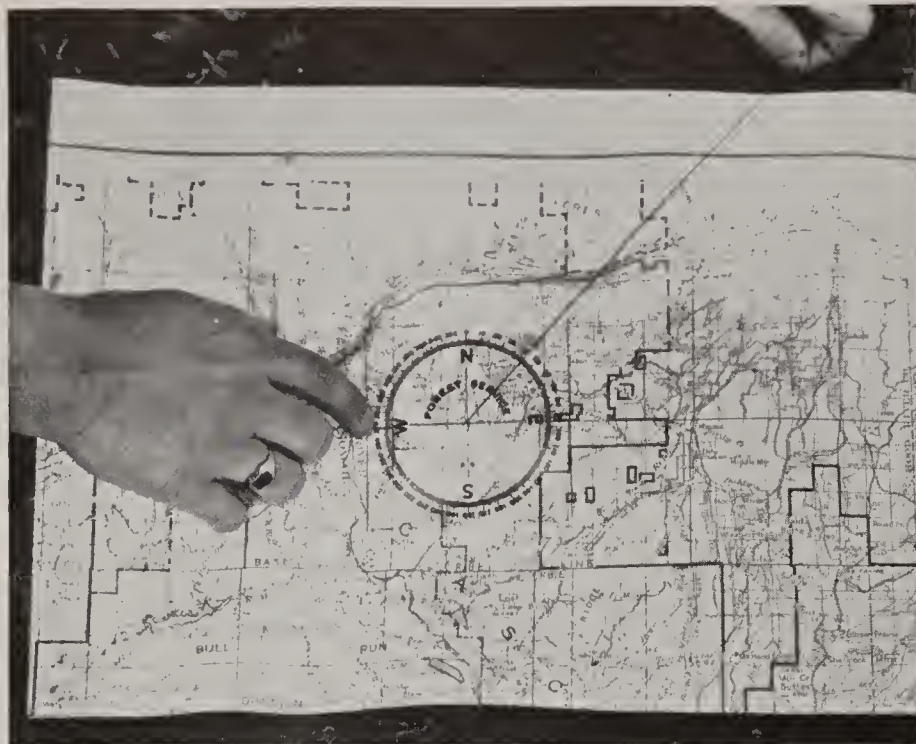


FIGURE B-6.—Smoke chaser's protractor.

Smoke Chaser's Protractor. (Index No. MSF-269. SDO-P.)

A small transparent protractor for use by smoke chasers in platting azimuths, made of Plastacele or other noninflammable material (fig. B-6). Printing is processed for durability. Equipped with 18-inch length of stout fishline for extending azimuth readings. Size of protractor, $4\frac{1}{4}$ inches square; diameter of azimuth circle, $3\frac{2}{3}$ inches. A heavy envelope is furnished to protect protractor when not in use.

Smoke Chaser Map Case. (Index No. 95.)

Designed for the convenience of smoke chasers in carrying and protecting maps. Inside dimensions, 6 by 9 inches. Made of 12-ounce olive-drab duck. Has flap at top with snap fastener and web loops at back for attaching to belt.

SECTION C
COMMUNICATION EQUIPMENT

SECTION C

COMMUNICATION EQUIPMENT

Radio Equipment. (R6-X and R6-P.)

All radio transmitters, receivers, and special parts and materials, other than replacement materials, are purchased by the Radio Unit, Portland, Oreg. All Forest Service requisitions involving radio transmitters (radiophones) must be cleared through the Radio Unit, Portland, Oreg., for assignment of call letters and frequency allocation. In addition to the usual data included in the requisition, there should also be indicated the national forest on which the equipment is to be used and the frequency assignment if an assignment has already been made.

Following is a description of Forest Service radio equipment. The weight and price data are for complete outfits ready to put in operation and include batteries unless otherwise stated. Prices are estimates only, based on recent purchases. Since radio equipment is being improved from time to time the prices indicated are quite susceptible to change.

Type P Radio Unit.

Transmits code (c.w.) only, but receives both voice and code. Its rated working range is 20 miles. This set was primarily designed for smoke-chaser use in extremely rugged country, where the last degree in portability is essential. The complete unit weighs only about 9 pounds but because it does not transmit voice has only a limited use. Approximate cost \$50.

Type PF Radiophone.

The type PF radiophone transmits and receives both voice and code (fig. C-1). It weighs about 15 pounds and has a rated working range of about 10 miles on voice and 20 miles when code is used. The PF was designed primarily for use by smoke chasers and the like where reasonably compact and portable voice-communication equipment is required. These sets are often carried by road and trail

crews, rangers, and other traveling forest officers, on fire trucks, and in some instances are made a part of fire outfits of 25-man size and larger. Approximate cost \$80.



FIGURE C-1.—Type PF radiophone.

PF Kit Box.

The PF kit box is a small chest similar to the SPF kit box illustrated (fig. C-2), which contains heavier batteries than are regularly furnished with the PF radiophone and a half-wave antenna for semipermanent installation. A compartment is also provided to house the PF radiophone. The kit box, batteries, and antenna, exclusive of the PF radiophone, weigh about 35 pounds. The PF kit box together with the PF radiophone were primarily designed to serve secondary lookouts (lookout firemen), small fire crews, and small construction or maintenance crews. In such lookout use, the half-wave antenna is permanently installed at the lookout and the PF radiophone plugged into the batteries contained in the PF kit box. Should the lookout need to take his radio set to a fire, it is necessary only to unplug the PF kit box battery cable, drop the set in the PF radiophone bag, which already contains batteries and short antenna, and he has a complete 15-pound voice set ready to go. Approximate cost \$15 for box and batteries.



FIGURE C-2.—SPF kit box containing SPF radiophone.

Type SPF Radiophone.

This unit employs the same transmitter as the PF. The receiver section is a sensitive

five - tube superheterodyne which requires less skill to operate than is necessary with the PF receiver. It can be operated on the same batteries as the type PF; that is, with portable or kit-box batteries. It is not recommended for use with portable batteries except in emergencies, because the battery drain is greater than on the PF. This unit is suitable for stand-by operation with kit-box or heavy-duty batteries, as it has a built-in loudspeaker. The SPF has a definitely greater communication range than the PF and is recommended to take the place of the PF where back packing is unnecessary or at most where it is limited to short distances. The SPF with carrying bag and portable batteries weighs about 20 pounds (fig. C-3). With

kit box and both kit-box and portable batteries the weight is approximately 58 pounds. Approximate cost, \$100.



FIGURE C-3.—Type SPF radiophone with portable battery set.

Type M Radiophone.

The type M radiophone is designed so that the transmitter, receiver, and loudspeaker are all built in one unit (fig. C-4). It is a voice and code transmitter-receiver weighing about 125 pounds. The rated working range is about 50 miles. The receiver is a highly selective superheterodyne. At present Hammerlund Comet Pro. Forest Service model is being used. The type M operates on a 110-120-volt, 60-cycle, a. c.—ordinary commercial current—not on batteries or other direct-current power. It may be plugged into any light socket or outlet where alternating current is available. Where 110-120-volt alternating current is not available, any one of the three portable generator units described hereinafter may be used to provide power for the set. The M radiophone has been especially designed for communication with the field from supervisors' headquarters and central equipment depots, and for use as a central communication station on large project fires.

Type M sets may be expected to cause interference over a radius of several hundred miles and should never be used except where lower powered sets will not furnish satisfactory communication. Where M sets are used they should be adjusted to emit the minimum power that will give satisfactory service. Approximate cost \$330.

Ultra-High Frequency Radio Equipment.

Ultra-high frequencies (UHF) have the limitation of being good only over optical or nearly optical ranges. Usually, for example, it is not possible to communicate between two points when the optical path between the antennas at the respective stations is obstructed by a hill or mountain. But where it is possible to use UHF equipment, it offers many advantages over the ordinary short-wave radio. There is practically no fading or static; the equipment can be made quite light and compact; the antenna is short, about 15 feet; receiver battery drain is small enough that stand-by operation of battery receivers is possible. Using one frequency for transmitting and another for receiving, a pair of stations may be operated duplex; that is, they may transmit and receive simultaneously.

UHF lends itself admirably to linking up emergency lookouts with the regular lookout system. It also has been used successfully for communication nets on large project fires.



FIGURE C-4.—Type M radiophone.

UHF operation is still quite new. In order to keep step with this progress and take advantage of new developments in circuits and parts, the Forest Service is making revisions in its ultra-high frequency equipment at relatively frequent intervals. Therefore, the following description of Forest Service UHF radiophones may be somewhat out of date with respect to the latest developments, though the same general types herein listed will be continued in a gradually improved form.

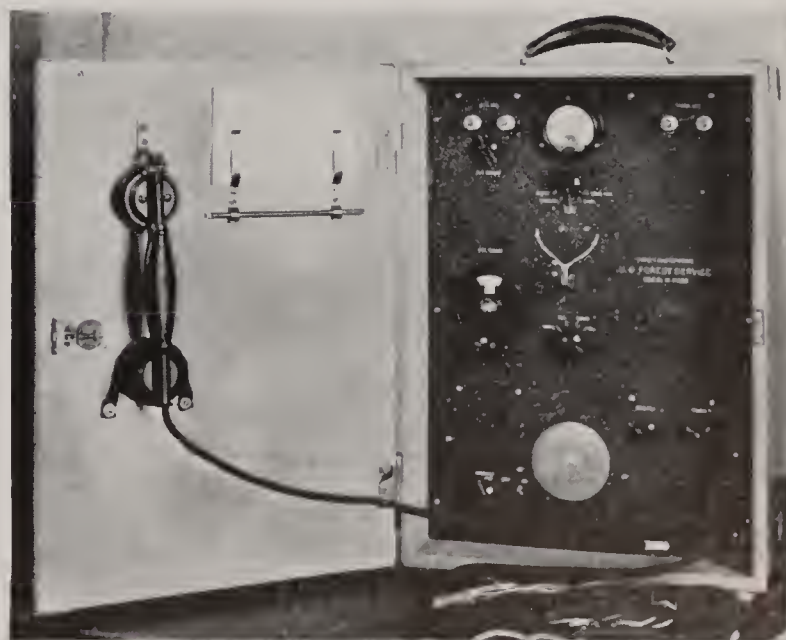


FIGURE C-5.—Type T (UHF) radiophone.

Type T Radiophone Transmitter-Receiver. (UHF.)

The type T radiophone transmits and receives voice only (fig. C-5). It weighs from 50 to 100 pounds, depending on the type of batteries used. Rated working range is about 100 miles over *optical paths*. The set is designed for stand-by operation and has a built-in loudspeaker. With this set it is possible to transmit and receive simultaneously when working

in airplane use (fig. C-7). It can be installed in practically any type of plane without special tools or mechanical skill; will communicate plane-to-ground over limited distances even in unshielded planes. Weight of complete radiophone, including dynamotor, but exclusive of storage battery, is about 40 pounds; operates from a 6-volt storage battery or from the storage batteries regularly incorporated in most airplanes. Approximate cost \$300.

Type U Radiophone.

This is an a. c.-operated ultra-high frequency radiophone transmitter-receiver especially intended for central station use such as at central fire dispatcher offices (fig. C-8). The unit is 19 inches wide, 4 feet 9 inches high, and 12 inches deep. The approximate shipping weight is 300 pounds. It has an output of about 20 watts. Approximate cost \$400.

The outstanding feature of this unit is its simplicity of operation. When a call is received on the stand-by loudspeaker, it is necessary only to pick up the hand-set to answer. Lifting the hand-set automatically turns on the transmitter. The U set communicates with the types T, S, A, and U ra-

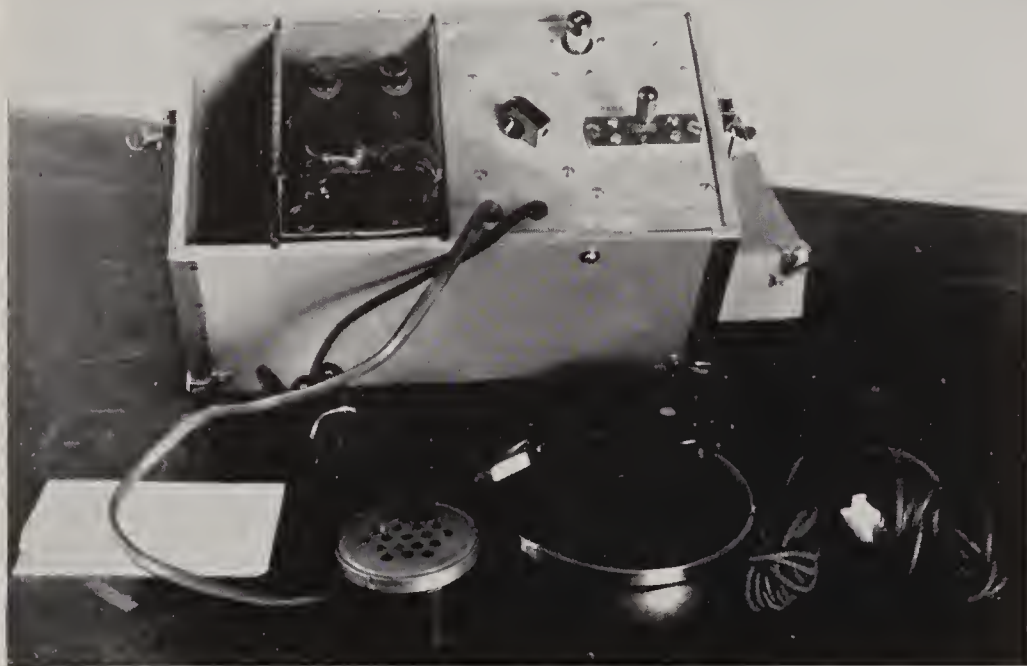


FIGURE C-6.—Type S portable (UHF) radiophone complete with accessories.

with another type T or U radiophone. Numerous battery combinations are available depending on the type of service. Approximate cost \$115.

Type S Radiophone Transceiver. (UHF.)

The type S radiophone transceiver transmits and receives voice only (fig. C-6). It weighs about 8 pounds. The rated working range is about 50 miles over *optical paths*. Working with antennas close to the surface over level ground the range may be reduced to no more than 3 or 4 miles. This set will not work duplex because the same circuit is used for both transmitting and receiving. It has been used by smoke chasers and by scouts and fire chiefs on large fires. Its principal features are its portability and the quickness with which it may be put into operation. Type S sets have occasionally been used for two-way communication with moving vehicles. Approximate cost \$33.

Type A Radiophone. (UHF.)

The type A radiophone has been especially designed to meet Forest Service requirements

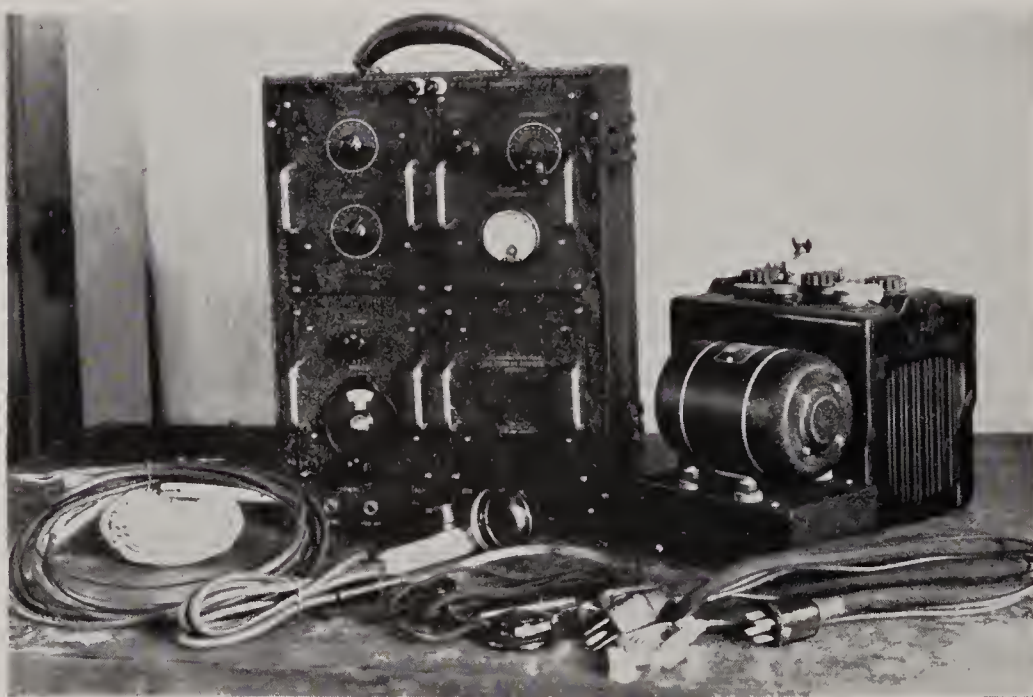


FIGURE C-7.—Type A (UHF) radiophone.

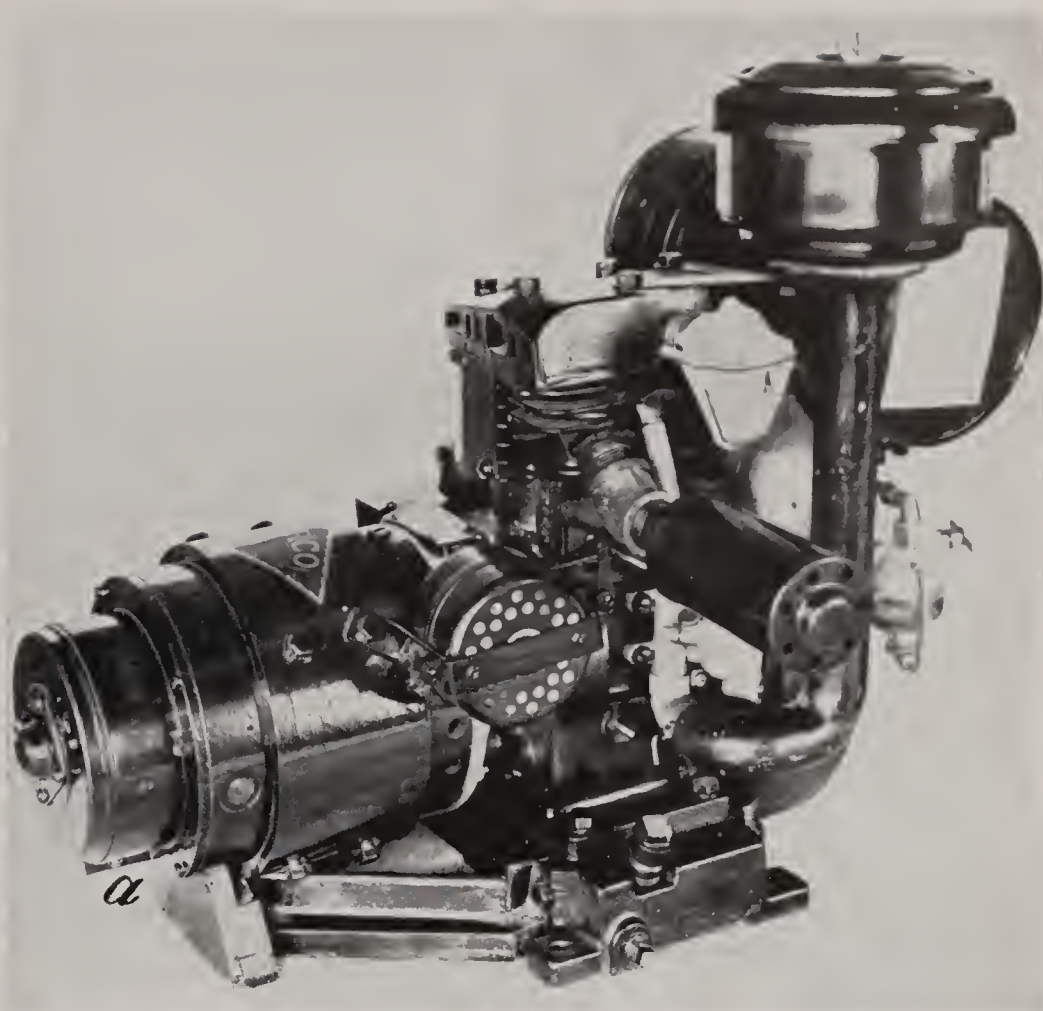
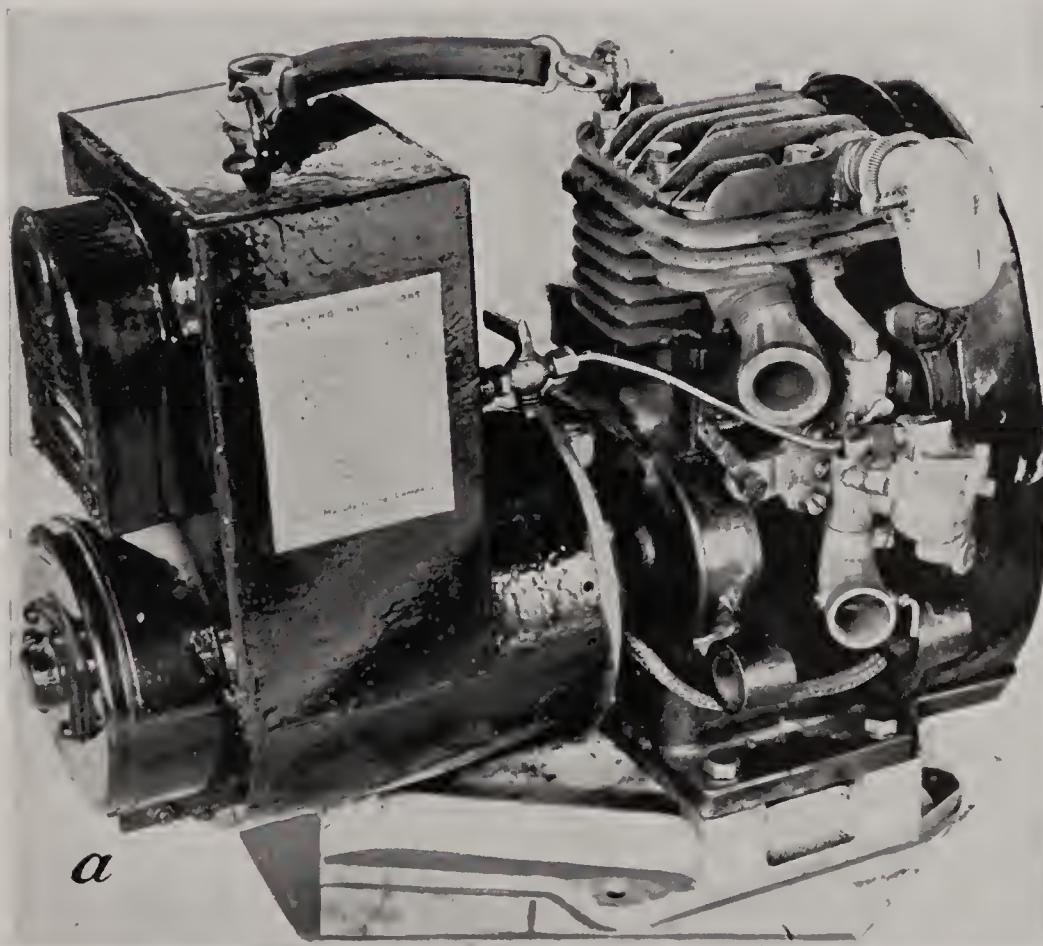
diophones and works duplex; that is, transmits and receives simultaneously with the type T and other U sets.

Generators, Portable, A. C. (Index No. 153. R6-X.)

Portable generators are obtainable in three sizes: 500 watt, weight about 90 pounds; 700 watt, weight about 105 pounds; and 1,000 watt,



FIGURE C-8.—Type U (UHF) radiophone.

FIGURE C-10.—*a*. Seven hundred-watt gas-driven generator.FIGURE C-9.—*a*. Five hundred-watt gas-driven generator.

weight not over 175 pounds. Each unit consists of a 110-120-volt 60-cycle AC. generator, directly coupled to a four-cycle, air-cooled engine which is radio-shielded. The units were designed especially for supplying power for radio communication, but will also supply incandescent-light power. They are not recommended for lighting service of a permanent nature, due to light construction and the fact that the unit is not self-starting. Models illustrated were made by the Garco Manufacturing Co., Seattle, Wash. (fig. C-9, C-10, C-11).

They have effective noise elimination from generator and engine and a high degree of voltage stability under varying electrical loads. There is no reason why other manufacturers of motor generators cannot build units meeting specification 153.

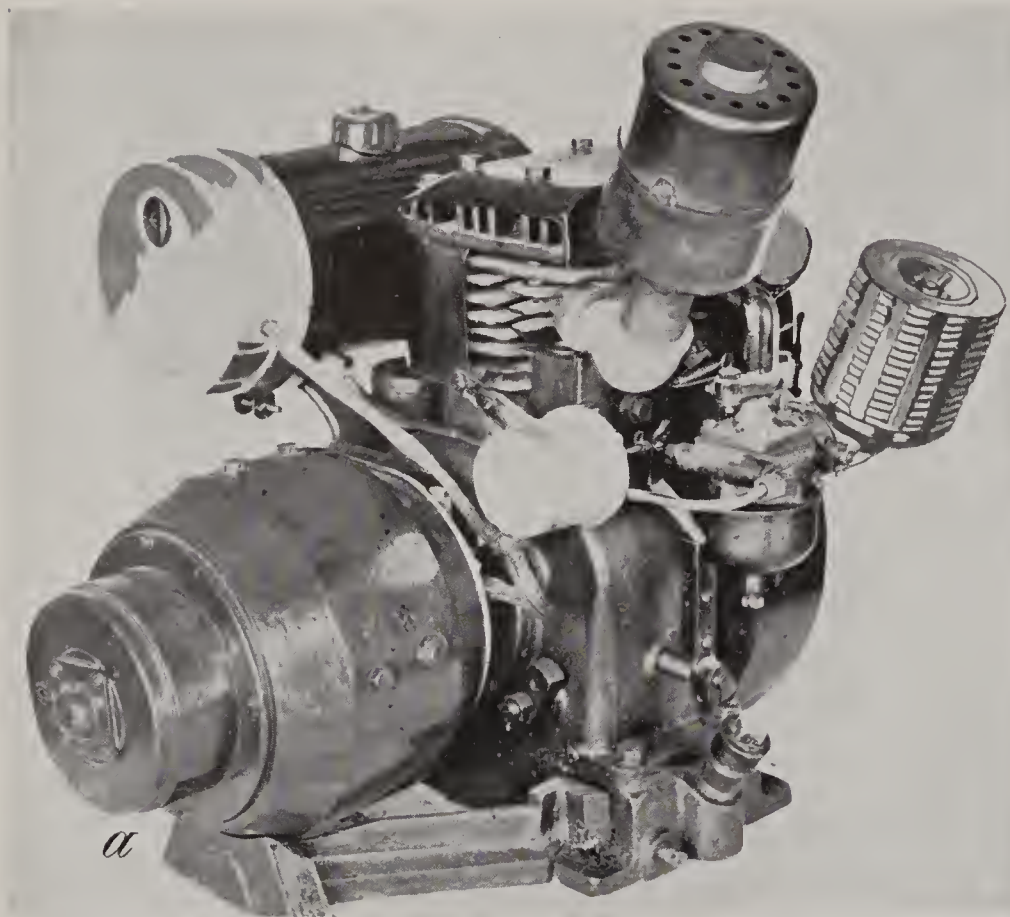


FIGURE C-11.—*a*. One thousand-watt gas-driven generator.

TELEPHONE INSTRUMENTS

Forest Service Telephone Handbook—X.

There are many different types of telephone instruments used throughout the Forest Serv-

ice. The Forest Service Telephone Handbook provides complete and detailed information regarding both telephone instruments and telephone lines; therefore, the data contained herein pertaining to this sort of equipment is confined to four types of instruments commonly used in connection with fire-control work.

Emergency Telephone Outfit. (Index No. 250-S.)

The emergency telephone outfit illustrated (fig. C-12) is used as standard fire-control equipment in certain localities. The outfit consists of two wooden boxes of the proper size to contain the following items:

Box No. 1

- 1 Standard 1317S wall telephone, or equal.
- 1 Set dry-cell batteries, installed.
- 1 Vacuum arrester No. 148057, or a neon-type arrester.
- 1 $\frac{1}{2}$ -inch by 6-foot copperweld ground rod, with clamp.
- 1 Screwdriver.
- 1 Roll friction tape.
- 1 Pair pliers.
- 3 Rolls emergency wire (1 $\frac{1}{2}$ miles single-conductor or $\frac{3}{4}$ mile double-conductor).



FIGURE C-12.—Emergency telephone outfit.

Box No. 2

- 8 Rolls emergency wire (4 miles single-conductor).
- 1 Emergency wire take-up reel, folding (index No. MSF-292).

The telephone instrument and the lightning arrester are installed within the box as shown and are ready for use. An extra-length generator crank is provided with this type of outfit, which is attached to the instrument through a hole properly located in the outer container so that the crank is conveniently located. As

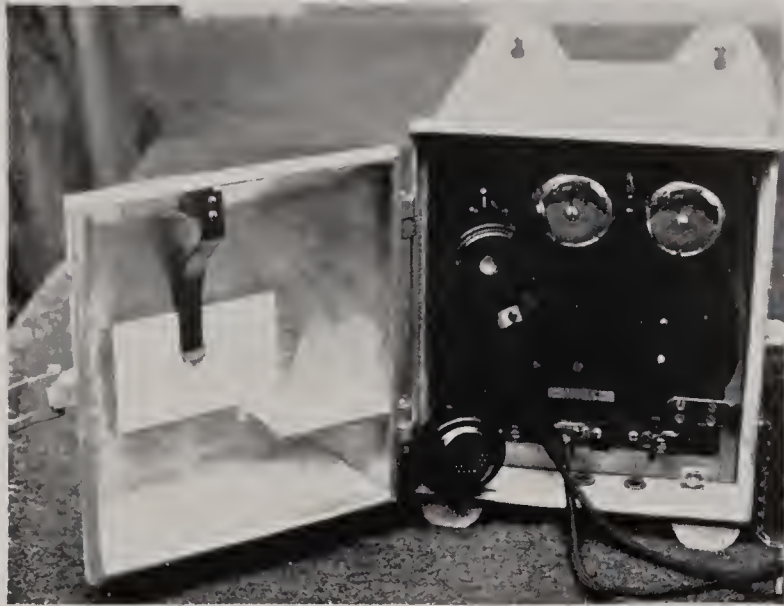


FIGURE C-13.—Model A-1 telephone, open.

indicated, box No. 1 is a complete communication outfit within itself, with sufficient wire provided to make short hook-ups.

Field Model A-1 Telephone.

A compact instrument with aluminum case containing essentially the same parts as a standard wall telephone, including five-bar generator and 2,500-ohm ringer (fig. C-13, C-14). Designed for convenient transportation to fire camps without damage in automo-



FIGURE C-14.—Model A-1 telephone, closed.

bile or truck or on pack horse. This instrument is also particularly adapted for outdoor installations at lookout patrol points, roadside call stations, etc. The case is so constructed as to protect the interior from the weather. Weight with batteries 39 pounds. Approximate cost \$46.

Model B Portable Telephone.

A hand-set with aluminum case for use by patrolman or others traveling on foot or on horseback (fig. C-15). Signal button operates

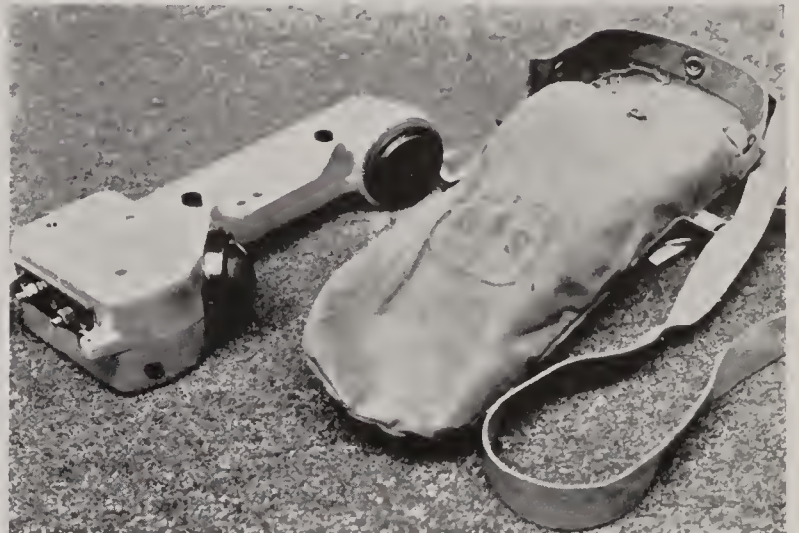


FIGURE C-15.—Model B portable telephone.

buzzer for calling stations equipped with standard telephone howlers. Stations which are not so equipped cannot be called with this instrument; nor can signals be received from other stations because neither ringer or buzzer is provided. Talking button closes transmitter circuit. Uses three-cell flashlight battery No. 790. The outfit includes canvas case, throw wire for line connection, and ground wire with small rod. Weight with batteries, 4½ pounds. Approximate cost, \$17.

Model C Portable Telephone.

A compact, lightweight telephone designed principally for rangers and automobile patrol-



FIGURE C-16.—Model C portable telephone.

men (fig. C-16). Hard maple case, five-bar generator, 2,500-ohm ringer, folding ringer handle. Uses three-cell flashlight battery No. 790. Weight with batteries, 19½ pounds. Cost approximately \$31.

Emergency Wire, Single-Conductor. (Index No. MSF-388-1.)

A strong but lightweight, rubber-covered telephone wire, the conductor consisting of 10 strands of No. 29 a. w. g., hard-drawn copper wire, twisted with approximately a 1½-inch lay. The wire is put on steel spools in lengths of approximately one-half mile, weighing about 17 pounds each. The insulation used is sufficient to withstand 4,000 volts after 1 hour's submersion in water. This feature makes the wire particularly adaptable to emergency use, where the telephone line is strung out through the woods, either hung up in bushes and trees or laid directly upon the ground. A spool of single-conductor wire is shown on the take-up reel illustrated (fig. C-17).

Emergency Wire, Double-Conductor. (Index No. MSF-388-2.)

This wire consists of two conductors twisted together with approximately four twists per foot of length. Each conductor is similar in construction to the single-conductor wire described. Double-conductor wire is put up in ¼-mile lengths on steel spools, each weighing approximately 18 pounds.

Emergency Wire Take-up Reel. (Index No. MSF-292.)

The emergency wire take-up reel is a simple device consisting of a galvanized sheet-metal frame with ¼-inch steel rod spool holder in which a lightweight crank and spool shaft are installed for rewinding wire (fig. C-17). The

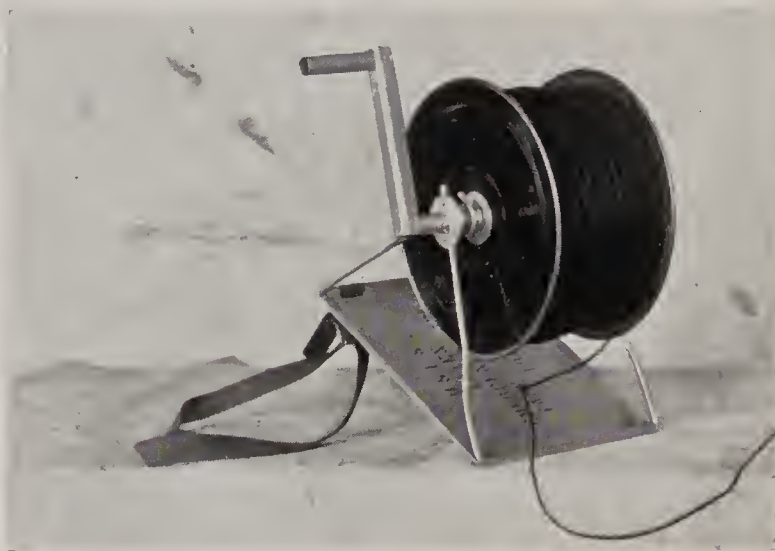


FIGURE C-17.—Emergency wire take-up reel.

reel is also useful in stringing out emergency wire, the spool being put on the holder in the same manner as for taking up, but the outfit carried either in the hand or upon the back of the person stringing the wire. When taking up wire with the reel, it is strapped to the chest of the operator so that the crank is immediately before him. The entire reel folds together into a very small, lightweight package.

SECTION D
LIGHTING EQUIPMENT

SECTION D

LIGHTING EQUIPMENT

Electric Headlight. (Index No. MSF-178. SDO-P.)

A specially designed headlight for night work or for foot and horse travel at night. The head lamp is small, light in weight, and contains a bright-finished reflector. Experience has shown that a larger lamp will cause headache after several hours' use.

The battery container is light, compact, and rectangular in shape with rounded edges, and holds two 2-cell batteries and an extra bulb. A two-way switch is provided so that the batteries may be used alternately to deliver a maximum of 3 volts to the 2.5-volt bulb. Tests have shown that with this arrangement, which permits one battery to recuperate while the other is connected, a usable light will be available continuously for about 8 hours. In addition to the advantage of using two batteries alternately rather than one 3-cell battery continuously, the rectangular container is much handier than a cylindrical container for carrying in the pocket or on the belt.

Electric Lantern. (Index No. 224.)

An electric lantern recommended for use with motor-vehicle equipment, power pumps, and for special work on fire suppression where a heavy-duty dependable light is needed. The light uses a twin-six battery which will furnish light for approximately 150 hours. The lens and reflector are large and give a powerful beam. The case is moisture proof; the reflector is bright finished, and the lens is of shatter-proof material.

Flashlight. (Index No. MSF-142.)

This specification is intended to provide a standard two-cell flashlight of rugged construction to withstand any sort of work to which a light of this nature should be subjected. The light provided is of the nonfocusing type with bright reflector and 2.5-volt globe using two standard 950 flashlight cells. The bottom cap is provided with a spring clip suitable for carrying an extra bulb. There is also attached to the bottom cap a swinging ring which makes it possible to hang up the flashlight.

Flashlight Batteries. (Index No. MSF-39-S.)

Federal Specification No. W-B-101a, as amended, will provide any sort of flashlight battery desired. If the standard 950 flashlight cell is required, the purchase order or bid should also specify that the battery be ac-

cording to type B-1d, cell designation D in table 1, of the foregoing Federal specification.

Floodlight, Battery-Power.

Certain Forest Service agencies have constructed a suitable type of portable, battery floodlight by using a regular automobile headlamp, to which is fastened an iron rod of the appropriate length to stick in the ground for holding the light upright. The battery box is constructed to contain either 8 or 16 No. 6 dry cells, and provided with handles for carrying. If of the eight-cell size, a single-throw switch is adequate; but if of the 16-cell size, a two-way switch should be provided and the batteries hooked up eight in a series. This latter method provides a light for just twice as long a period as the eight-cell arrangement. The connecting cord between the light and the battery box should be lightweight insulated lighting cord fitted at ends with detachable connector plug or socket.

Lookout Map-board Light. (Refer to sec. A, Detection equipment.)

Portable Generator. (Refer to sec. C, Communication equipment.)

Gasoline Lantern. (Index No. MSF-225.)

The type of gasoline lantern provided for by the specification is similar and equal in every respect to the commonly known Coleman two-mantle lantern. The specification provides for securing either the Q-type generator or the rotary, self-cleaner type, as may be preferred. It also provides that either mica or Pyrex chimney may be secured as preferred.

Gasoline Lantern Cartons. (Index No. 94-S.)

A specially constructed, lightweight, corrugated fiberboard box suitable for transporting gasoline lanterns. Boxes of this kind and for the purpose mentioned can be obtained by using the following specification as written.

Specification.—Corrugated fiber boxes for gasoline lanterns. Boxes to be 7 by 7 by 15 inches inside finished dimensions in accordance with style No. 1 (collapsible slotted container), board No. 1, table No. 1 of Federal Specification No. LLL-B-631a including any amendments thereto.

Funnels, Filter Type. (Refer to sec. N, Power pump accessories.)

Candles, Hard Type. (Index No. MSF-77-S.)

In order to secure a suitable type of candle for use in firemen's outfits and elsewhere, where a candle which will not soften and run is nec-

essary, Federal Specification No. C-C-91 should be used, specifying type 2, class A, thereunder.

Carbide, All Kinds. (Index No. MSF-90-S.)

Carbide is used in miners' lamps, of which there are doubtless a considerable number still on hand, although they are rapidly being replaced with electric headlights. It is also used in floodlights. Both types of carbide may be purchased under Federal Specification No. O-C-101, Section IV, part 5. Nut size, $1\frac{1}{4}$ by $\frac{3}{8}$ inches, should be specified for miners' lamps. Cake calcium carbide is manufactured in several sizes. The size desired for floodlights should be specified, also the make of the lamp in which the carbide is to be used. Granular calcium carbide, in most cases, is a byproduct from the manufacture of standard sizes and does not meet the required yield of 4.5 cubic feet per pound.

Airport Lighting Flare. (Index No. 140.)

This is a magnesium candle flare which provides a 75,000- to 80,000-candlepower light for a period of 3 minutes. It is for use at emergency landing fields in order to provide a light by which airplanes can be landed at night. The candles must be used with a hooded reflector in order that the light therefrom will not blind the pilot when landing (see index No. 299).

The most efficient way of using these lights is to use two at a time, placing them about 100 feet apart at the near end of the runway where the plane is to land, the reflectors focused down the runway similar to a pair of automobile lamps. One candle is ignited while the plane is maneuvering into position and then when the pilot begins to glide toward the field, the other candle should be ignited. This provides the maximum light of both candles at the time the plane lands and insures a sufficient period of light to complete the entire landing.

Airport Lighting Flare Reflector. (Index No. 299.)

The reflector is an inexpensive piece of equipment so designed that any tinsmith can manufacture it, and any jackknife carpenter can manufacture the tripod which supports the reflector (fig. D-1). The specification covers in detail the construction of both the reflector and the tripod stand. The reflector portion is manufactured with a bright tin backing over the top of which is placed a 24-gage galvanized-iron hood. The reflector is approximately 48 inches high by 30 inches wide, and is fastened to a hardwood triangular-shaped stem which fits into a socket in the tripod stand.

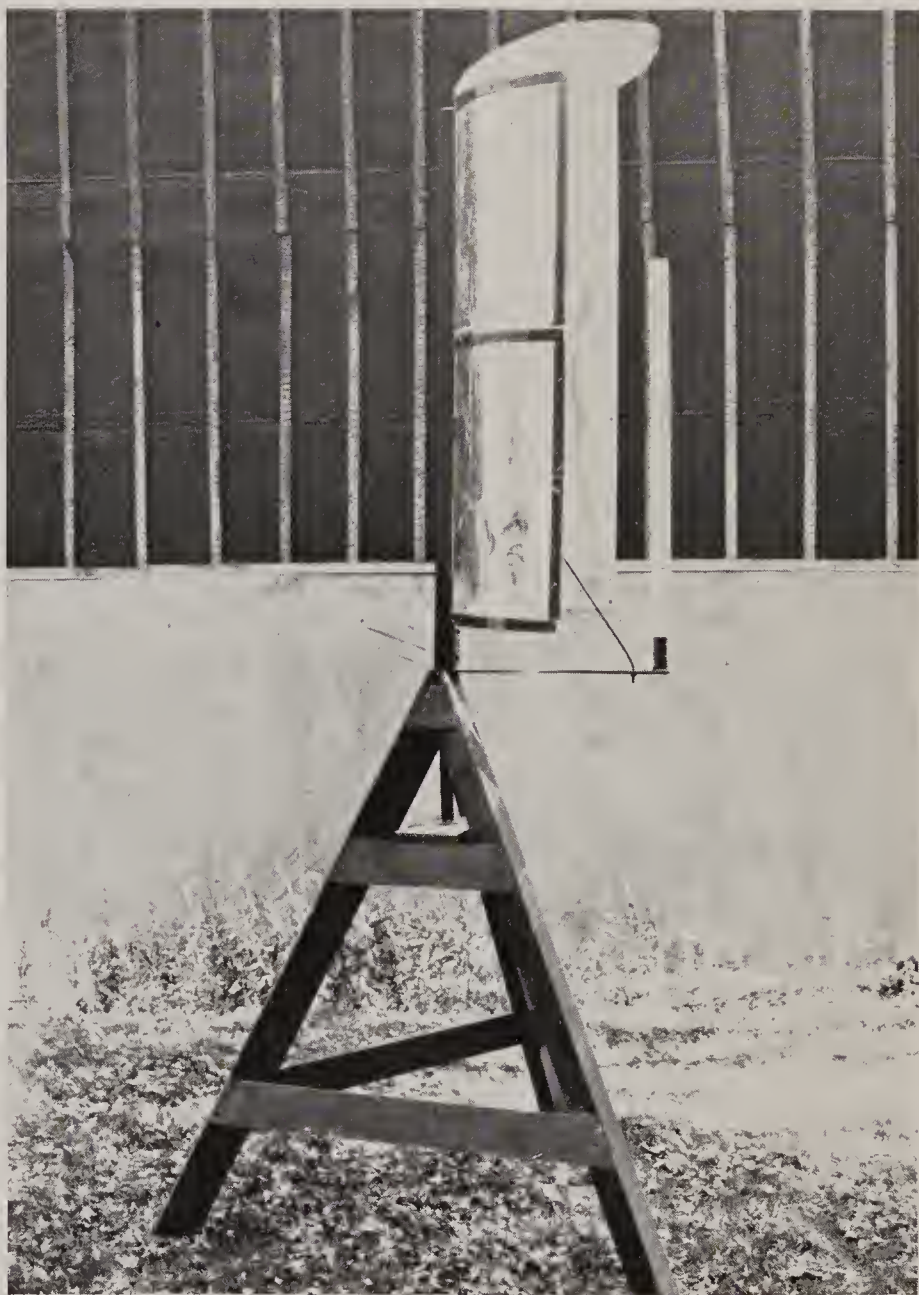


FIGURE D-1.—Airport lighting flare reflector.

SECTION E
CAMP EQUIPMENT

SECTION E

CAMP EQUIPMENT

Nested Cooking and Mess Outfits.

Nested cooking and mess outfits have been developed over a period of several years particularly for use in fire-control work, to provide adequate equipment for various sized crews and at the same time keep them compact and of minimum weight. Items of special

is particularly essential in Regions 1, 4, 5, and 6, where interregional exchanges of these outfits occur often. Unless the outfits and their contents are standard, confusion and difficulties result.

The following sizes in mess outfits have been adopted as standard for the Forest Service, and



FIGURE E-1.—One-, two-, and three-man nested mess outfits.



FIGURE E-2.—Six-man nested mess outfit.

manufacture have been designed, as far as possible, to make them interchangeable in the different sized outfits in which they are used.

With transportation facilities and the trend of fire-suppression activities such that interregional exchange of fire-control equipment is common occurrence, the need for standardization of nested mess equipment is obvious. It

standard lists of contents have been prepared to facilitate this particular phase of fire control. Also, standard specifications have been prepared for most of the individual items contained within the outfits. Individual items of mess equipment used in other than standard nested outfits should, wherever practicable, be standard items.

Standard sized outfits.—1-man, 2-man, 3-man, 6-man, 10-man, 25-man.

In addition thereto, two types of 50-man outfits, made up of standard items, are suggested for use where larger outfits are required.

Standard lists of contents.—The number of individual items listed as standard in any particular outfit may be modified for local use provided standard items are used where increases are made.

One-Man Nested Mess Outfit. (Fig. E-1.)
(Index No. MSF-247-1-S.)

Individual camp cooking outfits, complete with carrying case and shoulder strap and the following items:

- 1 Aluminum pudding pan, 7¼-inch diameter, 1½ inches deep, 1½-pint capacity.
- 1 Aluminum pail and cover, 5-inch diameter, 2⅝ inches deep, 1¾-pint capacity.
- 1 Tinned steel fork.
- 1 Tinned steel spoon.
- 1 Frying pan with folding handle.
- 1 Aluminum cup, 4-inch diameter, 2⅝ inches deep, ¾-pint capacity.

All articles to nest and pack between frying pan and pudding pan. Handle of frying pan to fit snugly over pudding pan and to hold outfit together securely. To be equal in every respect to the Aluminum Cooking Utensil Co.'s No. 1016.

Two-Man Nested Mess Outfit. (Fig. E-1.)
(Index No. MSF-247-2-S.)

- 1 Container, canvas.
- 1 Pan, frying, 9-inch.
- 1 Pail, aluminum, with cover, 4-quart, Wear-ever No. 877.
- 1 Pail, aluminum, with cover, 6-quart, Wear-ever No. 878.
- 1 Pan, 3-quart, tin.
- 2 Pans, 1-quart, tin.
- 1 Pot, coffee aluminum.
- 2 Plates, tin.
- 2 Cups, tin.
- 2 Knives, table.
- 2 Forks, table, tinned.
- 1 Spoon, dessert, tinned.

- 2 Teaspoons, tinned.
- 1 Knife, paring.
- 1 Knife, butcher, folding.
- 1 Can opener.

Three-Man Nested Mess Outfit. (Fig. E-1.)
(Index No. MSF-247-3-S.)

- 1 Container, canvas.
- 2 Pans, frying, 9-inch.
- 1 Pail, aluminum, with cover, 4-quart, Wear-ever No. 877.
- 1 Pail, aluminum, with cover, 6-quart, Wear-ever No. 878.
- 1 Pan, tin, 3-quart.
- 3 Pans, 1-quart, tin.
- 1 Pot, coffee, aluminum.
- 3 Plates, tin.
- 3 Cups, tin.
- 3 Knives, table.
- 3 Forks, table, tinned.
- 2 Spoons, dessert, tinned.
- 3 Teaspoons, tinned.
- 1 Knife, paring.
- 1 Knife, butcher, folding.
- 1 Can opener.

Six-Man Nested Mess Outfit. (Fig. E-2.)
(Index No. MSF-247-4-S.)

- 1 Container, canvas.
- 1 Pail, aluminum, with cover, 4-quart, Wear-ever No. 877.
- 1 Pail, aluminum, with cover, 6 quart, Wear-ever No. 878.
- 1 Pail, aluminum, with cover, 8-quart, Wear-ever No. 880.
- 1 Pail, aluminum, with cover, 9-quart, Wear-ever No. 881.
- 3 Pans, frying, 10-inch.
- 3 Pans, tin, 2-quart.
- 8 Pans, tin, 1-quart.
- 8 Plates, tin.
- 6 Cups, tin.
- 8 Spoons, dessert, tinned.
- 8 Forks, table, tinned.
- 8 Knives, table.
- 1 Knife, paring.
- 1 Knife, butcher, folding.
- 1 Stone, ax.
- 1 Can opener.
- 4 Kettle chains.
- 1 Clock, alarm.
- ½ Pound nails, sixpenny and twentypenny.
- 2 Towels, dish (cloth).
- 2 Towels, hand (cloth).
- 1 Lifter, pot.

Ten-Man Nested Mess Outfit. (Fig. E-3.)
(Index No. MSF-247-5-S.)

- 1 Container, tin.
- 1 Pail, aluminum, with cover, 8-quart, Wear-ever No. 880.
- 1 Pail, aluminum, with cover, 9-quart, Wear-ever No. 881.
- 1 Pail, aluminum, with cover, 11-quart, Wear-ever No. 882.
- 1 Pail, aluminum, with cover, 14-quart, Wear-ever No. 883.
- 2 Pans, frying, 10-inch.
- 2 Pans, frying, 12-inch.
- 3 Pans, pudding, 3-quart, tin.
- 14 Plates, tin.
- 12 Cups, tin.
- 1 Spoon, basting, 10-inch.



FIGURE E-3.—Ten-man nested mess outfit.

14 Spoons, dessert, tinned.
 12 Forks, table, tinned.
 12 Knives, table.
 1 Knife, paring.
 1 Knife, butcher, 8-inch.
 1 Stone, ax.
 1 Can opener.

4 Kettle chains.
 1 Alarm clock.
 1/2 Pound nails, tenpenny
 and twentypenny.
 3 Towels, dish (cloth).
 3 Towels, hand (cloth).
 1 Lifter, pot.

1 Pail, tin, 9-quart, 8 1/2
 inch diameter, 11
 inches deep, with
 cover.
 1 Potato masher.
 30 Pans, tin, 1-quart.
 12 Pans, tin, 3-quart.

1 Pail, tin, 13-quart, 9-
 inch diameter, 11 1/2
 inches deep, with
 cover.
 4 Pans, enamel, 3-quart.
 30 Plates, tin.
 30 Cups, tin.



FIGURE E-4.—Twenty-five man nested mess outfit.



FIGURE E-5.—Region 1, 25-man auxiliary mess box.

Twenty-Five Man Nested Mess Outfit. (Fig. E-4.) (Index No. MSF-247-6-S.)

1 Container, 25-man, galvanized iron.
 1 Cover, for 25-man container.
 2 Pails, half-oval, and covers, tin.
 1 Box, knife and fork, tin.

2 Pans, half-oval, tin.
 1 Pail, tin, 6-quart, 8-inch diameter, 10 1/2 inches deep, with cover.
 2 Pans, frying, 12-inch.
 1 Fork, meat.
 30 Forks, table, tinned.

1 Pail, tin, 16-quart, 9 1/2 inch diameter, 12 inches deep, with cover.
 30 Spoons, dessert, tinned.
 12 Spoons, table, tinned.
 2 Spoons, basting.
 1 Knife, butcher, 10-inch.
 1 Knife, butcher, 8-inch.
 2 Knives, paring.
 2 Lifters, pot.

3 Can openers.
 1 Cake turner.
 1 Egg whip.
 6 Kettle chains.
 1 Alarm clock.
 2 Files, 8-inch, flat, mill bastard.
 50 Bags, lunch, cellophane.
 30 Bags, lunch, cloth.
 1 Stone, ax.

- | | |
|---|------------------------------|
| 10 Towels, dish, cloth. | 2 Pounds nails, forty penny. |
| 150 Paper towels or 25 small cloth hand towels. | 1 Brush, pastry, 2-inch. |
| 2 Pounds nails, twenty penny. | 4 Soap, hand. |
| | 4 Soap, laundry. |

Auxiliary Mess-Equipment Box (R-1 type).

In Region 1 a wooden box, containing the mess and camp equipment listed below, is used to supplement the standard 25-man outfit (fig. E-5).

- | | |
|----------------------------|--|
| 1 Dishpan, 21-quart. | 2 Pans, fry. |
| 2 Funnels, filtering type. | 1 Saw, meat, complete. |
| 3 Generators, gas-lantern. | 25 Towels, hand, cloth. |
| 1 Hammer, claw. | 4 Wash basins. |
| 2 Lanterns, gasoline. | 4 Water buckets, canvas. |
| 24 Mantles, gas-lantern. | 1 Wrench, lantern. |
| 1 Mosquito bar. | 2 Gallons gasoline (separate container). |

Fifty-Man Nested Mess Outfit Region 5. (Index No. 247-8-S.)

In Region 5 a 50-man nested mess outfit (fig. E-6) is assembled by using two of the metal containers (MSF-247-12) and other standard equipment listed as follows:

- | | |
|--|---|
| <i>Unit A</i> | 1 Pail, tin, round, 8 by 10 inches, with cover. |
| 1 Container, metal, and cover. | 1 Box, tin (knives, forks, etc.). |
| 2 Pans, tin, half-oval. | 2 Can openers. |
| 2 Pails, tin, half-oval, with covers. | 54 Cups, tin. |
| 2 Pails, tin, round, 9 by 12 inches, with cover. | 54 Knives, table. |
| 1 Pail, tin, round, 8½ by 11 inches, with cover. | 54 Forks, table. |
| | 1 Knife, butcher, 8-inch. |
| | 1 Knife, butcher, 10-inch. |
| | 2 Knives, paring. |

- | | |
|-------------------------|---|
| 2 Lifters, pot. | 3 Spoons, basting. |
| 54 Pans, 1-quart. | 50 Bags, lunch, cellophane. |
| 60 Plates, tin. | 3 Pound nails, sixpenny. |
| 54 Spoons, dessert. | 3 Pound nails, tenpenny. |
| 12 Spoons, table. | 3 Pound nails, twenty-penny. |
| 12 Towels, hand, cloth. | 4 Pans, frying, 12-inch. |
| 12 Towels, dish. | 4 Pans, baking, 20 by 11½ by 2½ inches. |

Unit B

- | | |
|--------------------------------|---|
| 1 Container, metal, and cover. | 5 Pans, 4-quart, tin. |
| 3 Waterbuckets, canvas. | 5 Pans, 3-quart, tin. |
| 5 Wash basins, tin. | 1 Package paper hand towels, 150 to roll. |
| 1 Egg beater, wire whip. | 1 Stone, ax. |
| 1 Fork, meat. | 1 Saw, meat. |
| 1 Hatchet, claw. | 1 Cake turner. |
| 6 Knapsacks, white. | |
| 2 Ladles, soup. | |

Fifty-Man Nested Mess Outfit Region 1.¹ (Index No. 247-7-S.)

In Region 1, to provide a 50-man mess outfit (fig. E-7), the Region 1 25-man outfit as heretofore described is augmented with an additional metal container (MSF-247-12) in which the following standard equipment is packed:

- | | |
|------------------------|---------------------------|
| 2 Pails, half-oval. | 25 Bags, cloth, lunch. |
| 25 Pans, 1-quart, tin. | 50 Bags, cellophane. |
| 25 Cups, tin. | 8 Headlights, electric.* |
| 25 Forks, table. | 48 Batteries, dry-cell.* |
| 25 Knives, table. | 2 Knapsacks (packsacks).* |
| 25 Plates, tin. | 2 Bags, water, man pack.* |
| 25 Spoons, dessert. | |
| 25 Towels, hand. | |
| 4 Pans, 3-quart, tin. | |

¹ Although items marked with an asterisk (*) are not mess equipment, they are packed with the mess outfit for convenience in transporting complete fire-equipment units.



FIGURE E-6.—Fifty-man nested mess outfit—Region 5.



FIGURE E-7.—Fifty-man nested mess outfit—Region 1 (metal containers only; see fig. E-5 for auxiliary box and contents).

Individual Mess-Equipment Items.

Listed hereinafter are all of the individual items of mess equipment, standard and otherwise, which are contained in the various outfits described hereinbefore. As previously indicated in the Foreword, the specification for the item concerned is contained within the handbook whenever the letter S appears immediately after the index number thereof. Index numbers to which the letter S is not affixed denote that detailed specifications for the items concerned are contained within the master file. This latter class of items is comprised of containers and other specially manufactured items.

OUTSIDE CONTAINERS

Two-, Three-, and Six-Man Outfit Containers. (Index No. MSF-247-10.)

Constructed of khaki duck (fig. E-8).



FIGURE E-8.—Canvas containers for two-, three-, and six-man outfits.

Ten-Man Outfit Container. (Index No. MSF-247-11.)

Constructed of XXXX charcoal tin; dimensions, 14 inches high by $12\frac{3}{8}$ inches in diameter (fig. E-3.)

Twenty-Five and Fifty-Man Outfit Containers. (Index No. MSF-247-12.)

Constructed of galvanized iron or of sheet metal and heavily retinned, as required (fig. E-4). Container is provided with adjustable chain fasteners so as to allow a 5-inch extension in height by raising the cover, which is 7 inches in depth. The container is 26 inches long, 13 inches wide, and $16\frac{1}{2}$ inches high.

Special Pans, Pails, and Boxes.

Half-oval pan----- Index No. MFS-247-14.

Half-oval pail and cover ----- Index No. MFS-247-15.

Round tin pails and covers (nestable) - Index No. MFS-247-16.

Aluminum pails and covers (nestable) - Index No. MFS-247-17-S

Knife and fork box, 25- and 50-man-- Index No. MFS-247-18.

The half-oval pans and pails are constructed of XXXX charcoal tin. The round tin pails are constructed with XXXX charcoal tin bottoms and XXX charcoal tin sides. All tin covers are made of XXX charcoal tin. There is only one size of half-oval pans and half-oval pails and four sizes of round tin pails.

The aluminum pails and covers are of the Wearever type and are of seamless construction. Refer to figure E-9 and the table of dimensions given thereunder for further details concerning the nestable pails. The half-oval pan and pail are illustrated in figure E-4.



FIGURE E-9.—Tin and aluminum pails and covers.

The 25- and 50-man knife and fork box is constructed of XXXX charcoal tin. It is also illustrated in figure E-4.

The following table gives the illustration reference numbers of the individual, nestable pails and covers, also the capacity and dimensions of each:

ALUMINUM WARE

Reference No.		Capa- city	Diam- eter	Depth	Quality
Pail	Cover				
		<i>Quarts</i>	<i>Inches</i>	<i>Inches</i>	
33	23	14	11	8 ⁵ / ₈	Wearever No. 883.
34	24	11	10 ³ / ₈	8	Wearever No. 882.
35	25	9	9 ⁵ / ₈	7 ¹ / ₄	Wearever No. 881.
36	26	8	9	7 ¹ / ₂	Wearever No. 880.
37	27	6	8 ¹ / ₈	6 ⁷ / ₈	Wearever No. 878.
38	28	4	7 ¹ / ₄	5 ¹ / ₂	Wearever No. 877.

TINWARE

39	29	16	9 ¹ / ₂	12	
40	30	13	9	11 ¹ / ₂	
41	31	9	8 ¹ / ₂	11	
42	32	6	8	10 ¹ / ₂	

COFFEE POT, BAKING AND FRYING PANS

Baking or Drip Pans. (Index No. MSF-247-21-S.)

To be made of pressed steel, 27-gage, tapered sides and ends. Upper edge to be lapped over a No. 9 copper-clad iron wire. Loop handles of No. 9 wire on each end. Dimensions may be varied to suit local conditions. A pan 11¹/₂ inches wide, 20 inches long at the top, and 2¹/₂ inches deep will fit the Region 5, 50-man outfit. (Refer to fig. E-10, items 17 and 18.)

Frying Pans, Folding Handle. (Index No. MSF-247-22-S.)

To be of 0.03125-gage, smooth steel, with folding handle. Similar in design and work-

manship to the folding-handle skillet manufactured by the United Steel & Wire Co., Battle Creek, Mich. To be of the following approximate dimensions:

<i>Diameter at top</i>	<i>Diameter at bottom</i>	<i>Depth</i>
9 inches.	7 inches.	2 inches.
10 inches.	8 inches.	2 inches.
12 inches.	10 inches.	2 inches.

(Refer to fig. E-10, items 19, 20, 21 illustrate 12-, 10-, and 9-inch pans.)

Coffee Pot, Aluminum. (Index No. 247-23-S.)

Five inches in diameter, 7¹/₈ inches deep, with folding handle, hinged lid, and bail, capacity 2¹/₄ quarts, equal in material and workmanship to that sold under the Wearever brand. (Refer to fig. E-10, item 22.)

PUDDING PANS, PLATE, AND CUP

Pudding Pan, Granite, 3-quart. (Index No. MSF-247-25-S.)

Granite, seamless, deep pattern, top diameter 9¹/₄ inches, depth 3 inches, capacity approximately 3 quarts. (Refer to fig. E-11, item 46.)

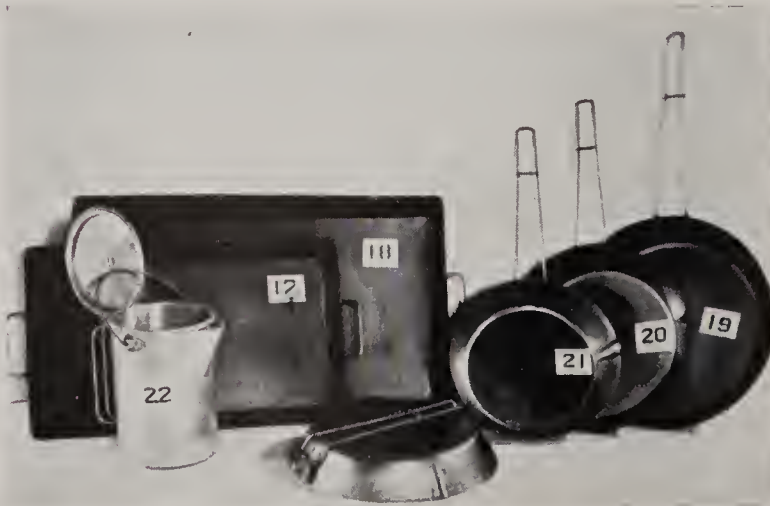


FIGURE E-10.—Baking pans, frying pans, and coffee pot.

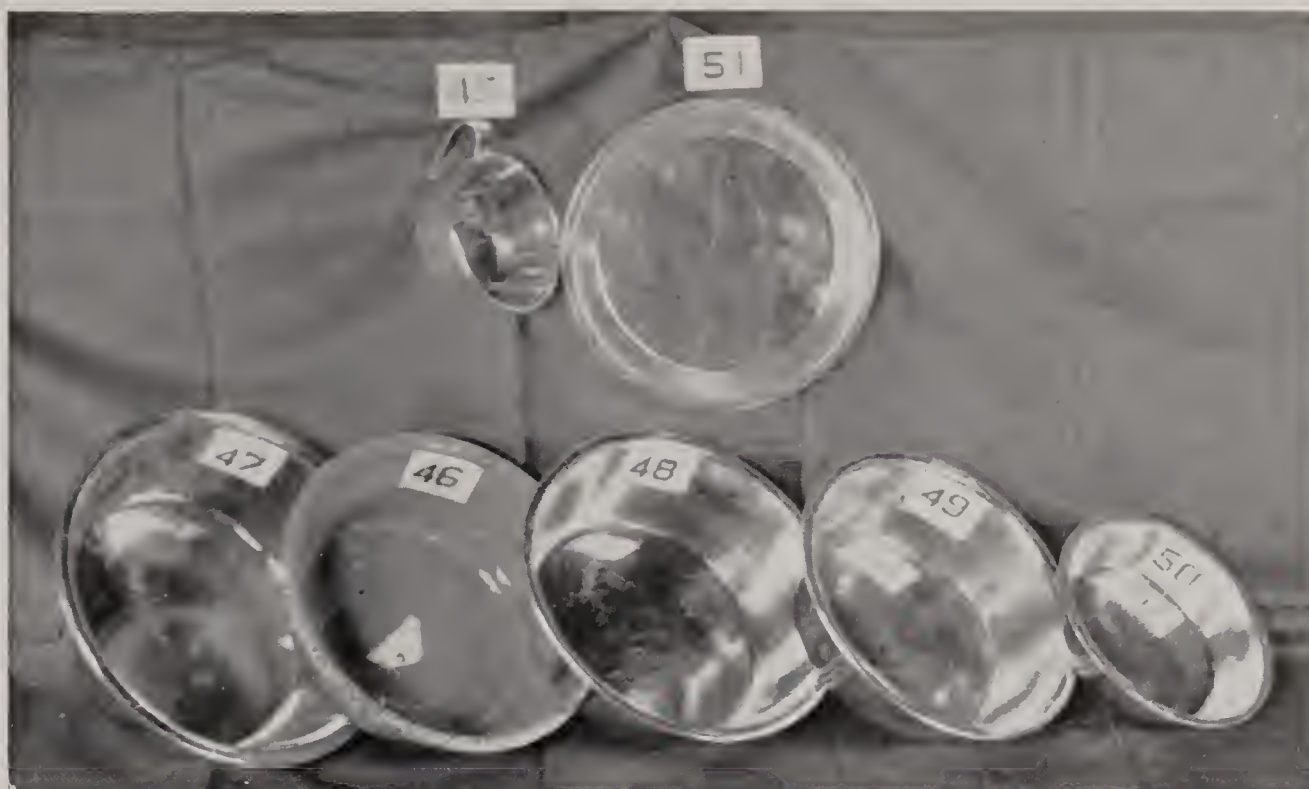


FIGURE E-11.—Pudding pans, plate, and cup.

Tin Pans

To be IC *retinned* and of the following dimensions and approximate capacity:

Capacity	Top diameter	Depth	Index No.
<i>Quarts</i>	<i>Inches</i>	<i>Inches</i>	
4	10 $\frac{1}{4}$	3 $\frac{1}{4}$	MSF-247-26-S
3	9 $\frac{1}{4}$	3 $\frac{1}{4}$	MSF-247-27-S
2	8 $\frac{1}{2}$	3	MSF-247-28-S
1	7 $\frac{1}{4}$	2 $\frac{3}{8}$	MSF-247-29-S

(Refer to fig. E-11, items 47, 48, 49, 50 which illustrate the 4-, 3-, 2-, and 1-quart pans respectively.)

Tin Plate. (Index No. MSF-247-30-S.)

IC tin, outside top dimension, 9 inches, and from 1 to 1 $\frac{1}{4}$ inches deep. (Refer to fig. E-11, item 51.)

Tin Cup. (Index No. MSF-247-31-S.)

No. 2 California or miner's patterns, 4 $\frac{5}{8}$ inches across the top outside, 2 $\frac{1}{8}$ inches deep, approximate capacity, 1 pint, to be IC *retinned*, seamless material with handle riveted at the top and open at the bottom to allow nesting. (Refer to fig. E-11, item 45.)

KNIVES, FORKS, SPOONS, AND MISCELLANEOUS ITEMS

Butcher Knife, Plain. (Index No. 247-35-S.)

Blade of first-quality steel well ground on cutting edge, handle to be riveted with either steel or brass rivets, Universal No. 1213 or equal. Length of blade 8 or 10 inches, as required.

Butcher Knife, Folding-Blade. (Index No. 247-36-S.)

Dimensions, design, and materials similar and equal to Marble's safety fish knife No. 78.

Paring Knife. Index No. 247-37-S.)

Blade 3 to 3 $\frac{1}{2}$ inches long, of fine-grade steel, steel-riveted beechwood handle, length over all not to exceed 6 $\frac{1}{2}$ inches.

Table Knife. (Index No. MSF-247-38-S.)

Iron or steel, heavily retinned, weight per dozen, 2 $\frac{1}{4}$ pounds.

Meat Fork. (Index No. 247-39-S.)

Two-pronged riveted wood handle, length over all, 12 $\frac{1}{2}$ inches, weight per dozen approximately 3 pounds.

Table Fork. (Index No. MSF-247-40-S.)

Iron or steel, heavily retinned, four-pronged, weight per gross, 12 pounds, Wallace Bros. No. 802 or equal.

Basting or Stirring Spoon. (Index No. 247-41-S.)

Forged steel, retinned, eyelet in handle, length over all, 10 or 13 $\frac{1}{2}$ inches, as required.

Tablespoon. (Index No. MSF-247-42-S.)

Iron or steel, heavily retinned, weight not less than 13 pounds or more than 15 pounds per gross, Wallace Bros. No. 802 or equal.

Dessert Spoon. (Index No. MSF-247-43-S.)

Iron or steel, heavily retinned, weight not less than 10 pounds or more than 12 pounds per gross, Wallace Bros. No. 802 or equal.

Teaspoon. (Index No. MSF-247-44-S.)

Iron or steel, heavily retinned, weight not less or more than 8 pounds per gross, Wallace Bros. No. 802 or equal.

Soup Ladle. (Index No. 247-45-S.)

Solid, retinned, top diameter 4 inches, weight per dozen 4 pounds.

Pot Lifter. (Index No. 247-46-S.)

Forged steel, heavily retinned, approximately 8 inches long, similar to Aluminum Cooking Utensil Co. No. 159.

Potato Masher. (Index No. 247-47-S.)

Wire, retinned, face 3 by 3½ inches, length over all 9½ inches, weight approximately 4½ pounds per dozen.

Cake Turner. (Index No. MSF-247-48-S.)

Straight off-set flexible blade with upper edge sharpened for cutting or chopping food, left edge blunt for turning food; beech handle with brass, compression rivets, approximately 9 inches long, 3 inches wide.

Pastry Brush. (Index No. 247-49-S.)

Flat 2-inch varnish brush, Federal Stock Catalog No. 38-B-5140.

Can Opener. (Index No. 247-50-S.)

Combination can opener and corkscrew, all-steel frame, Yankee pattern.

Egg Whip. (Index No. 247-51-S.)

French style, tinned wire, wire-bound handle, five bows, length 12 inches, weight approximately 3¾ pounds per dozen.

Kettle Chains. (Index No. MSF-247-52-S.)

Length 3 feet, 13-gage twist link, bright-finished coil chain, with 10-gage S-hook 2 inches long on both ends. To be placed in bundles of 25 each with hook ends wrapped with burlap or other material to prevent tangling in shipment.

Meat Saw. (Index No. 247-53-S.)

Butcher saw, protected steel frame, 18-inch detachable blade.

Lunch bag, Cellophane. (Index No. MSF-247-54-S.)

Transparent, square type, 6 inches wide, 3½-inch bellows, 13 inches long, to be made of No. 450 plain Cellophane or of a material similar and equal thereto.

Washbasin. (Index No. 247-55-S.)

Retinned, diameter approximately 12¼ inches.

Dishpan. (Index No. 247-56-S.)

Charcoal plated, retinned IXX, capacity 17 quarts, size 17¾ by 5¾ inches, weight 27 pounds per dozen.

Dish Toweling. (Index No. 247-57-S.)

When obtainable, misprint flour sacks make satisfactory and economical dish towels. Unbleached sheeting, Federal specification No. CCC-S-281, type B, 36 inches wide, is also recommended.

Hand Towels, Cloth. (Index No. 247-58-S.)

Huck, Federal specification DDD-T-531.

Hand Towels, Paper. (Index No. 247-59-S.)

Flat, 50 percent sulphite and 50 percent ground wood, weight 32 pounds, junior size (10¾ by 11 inches), 150 to package.

Ax Stone. (Index No. MSF-329.) (Refer to sec. H, Grinding equipment.)**Water Bag, Manpack.** (Index No. MSF-37.) (Refer to Sec. O, Water equipment.)**Alarm Clock.** (Index No. MSF-99-S.)

Similar in size and design and equal as to materials, workmanship, and dependability to the Junior Tattoo as manufactured by the New Haven Clock Co.

Knapsack (Packsack). (Index No. MSF-214.) (Refer to sec. J, Back packing equipment.)**Cloth Lunch Bag.** (Index No. MSF-247-60-S.)

Bag to be manufactured from unbleached cotton sheeting, in accordance with Federal Specification No. CCC-S-281, table 1, type C, as amended. Sheet, size 18 by 21 inches, to be folded double and sewed one side and bottom, then turned to form bag. Sewing to be done with three-ply No. 12 thread in the needles and two-ply No. 12 thread in the looper. Selvage top, not hemmed. Finished size approximately 10 by 17 inches.

Canvas Bucket. (Index No. MSF-68.)

A canvas bucket approximately 14 inches in diameter by 14 inches in depth. Top and bottom hems are strengthened with a heavy wire ring. It has a rope-inserted handle. The bucket is similar to the Army-type bucket.

Milk Cans, 5- and 10-Gallon. (Refer to sec. O, Water carrying equipment.)**CAMP-BOSS OUTFIT CONTAINERS**

The type of camp-boss outfit container used is governed to a great extent by the various methods of transportation available and also by the size of fire-suppression crews usually employed. There are several different designs of containers, each one of which undoubtedly fulfills the need of certain localities. In order to provide handbook users with a choice of the type of container which will most nearly meet local conditions several different types are included.

Camp-Boss Outfit Container, Ranger's Canvas Carrying Case.

In certain localities the standard canvas rangers' carrying case has been used as a camp-boss or fire timekeeping outfit container. This container is rather small, however, and precludes any possibility of including other than

the necessary stationery supplies and forms essential for timekeeping, and camp equipment and supply inventory and requisition forms.

The camp-boss outfit, wherever referred to as such, is intended to include the necessary essentials for fire timekeeping as well as fire camp management. In some Regions where transportation is not a material problem these outfits assume rather elaborate propor-



FIGURE E-12.—Large metal Camp-boss outfit container.

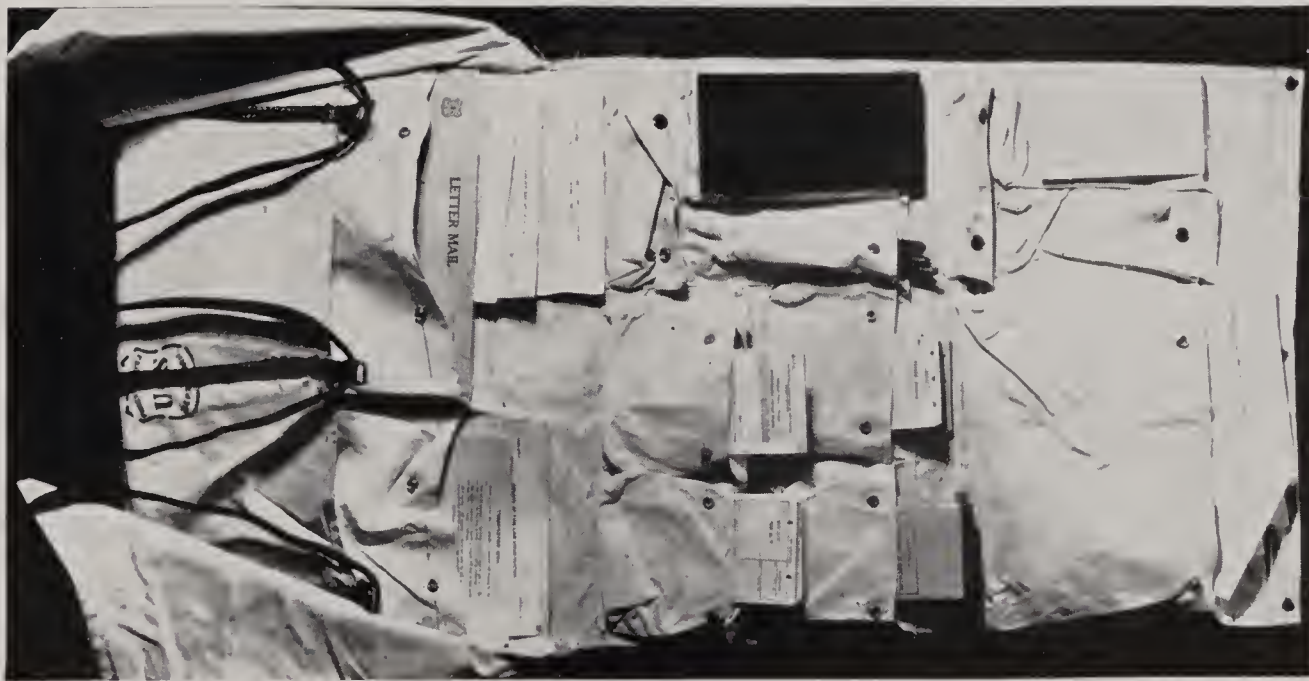


FIGURE E-13.—Camp-boss outfit container, canvas, open.

into three compartments, $2\frac{1}{2}$, 3, and $4\frac{1}{2}$ inches in width, respectively.

Camp-Boss Outfit Container, Canvas. (Index No. MSF-251-3.)

This particular outfit which is used rather widely provides a very compact outfit, in that it will roll up with any required amount of contents contained

tions and no attempt has been made to devise a standard or even suggest a list of contents for a camp-boss outfit, since local conditions vary to such an extent as to make such lists impracticable.

Camp-Boss Outfit Container, Large, Metal.
(Index No. MSF-251-1.)

A metal chest constructed of 24-gage, galvanized iron and provided with handles, hasp, and staple (fig. E-12). The box is approximately 25 inches in length by 10 inches in width by 10 inches in depth. The top of the chest or box is provided with a shallow tray which rests upon two partitions which subdivide the lower part of the container lengthwise

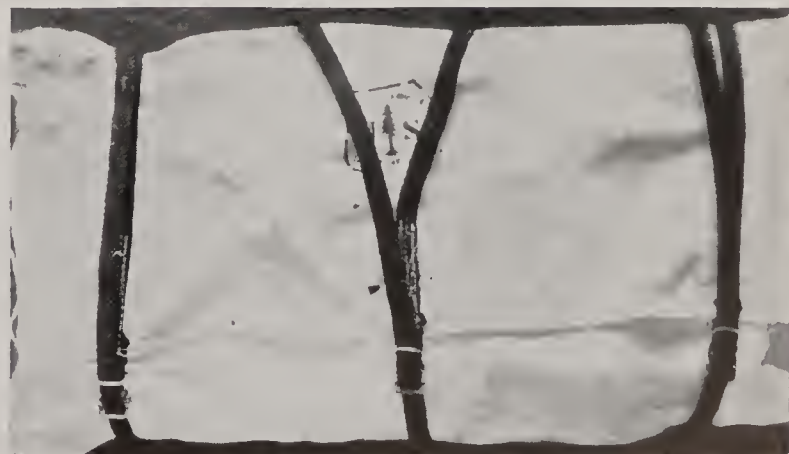


FIGURE E-14.—Camp-boss outfit container, canvas, rolled.

therein (figs. E-13, E-14). It is constructed of 10-ounce canvas and is provided with vari-

ous sized pockets, each with a button flap. The pockets are so arranged that the container, when filled, can be folded and rolled up within the extended end flap and tied securely with straps. The top flap is provided with three grommets in order that the entire outfit may be hung up on a tree or elsewhere while in use. Approximate dimensions when open, 23 inches wide by 60 inches long, with two 16-inch flaps extending out 15 inches on each side, which are used to fold in to close the ends of the roll when the outfit is packed. The dimensions when closed, of course, will vary accord-

Shoe-Repairing Outfit.

In certain localities shoe-repairing outfits are still included within standard fire-camp equipment. The use of this type of equipment is so limited, however, that no specification has been prepared. The following is a list of contents suggested by one of the Regions for a shoe-repairing outfit:

1 14-inch stand.	4 to 6 ¼-pound packages
1 9-inch last.	⅜-inch hungarian nails.
1 10-inch last.	2 Packages assorted sizes
1 Shoemaker's hammer.	of shoe nails.
1 Pegging awl.	1 Canvas container.



FIGURE E-15.—Kapok sleeping bag.

ing to contents, but with the normal camp-boss outfit will approximate a package 14 by 23 inches by 5 to 8 inches thick.

Camp-Boss Outfit Container, Metal, Small. (Index No. MSF-251-2.)

A slight smaller metal container than the one preceding, constructed on the order of a small suitcase and provided with a single handle, hasp, and staple. Material used in construction is 24-gage galvanized iron.

The approximate dimensions of the container are: length 21 inches, width 15 inches, depth 6 inches. The bottom part of the container is subdivided into three compartments 3½ by 10½ inches, 10½ by 11¾ inches, and 10¼ by 14¾ inches, respectively.

The cover is provided with several filing pockets or pigeonhole compartments for pencils, paper clips, small papers, etc. A 1-inch tray is provided which sets upon the lower compartment partitions and which is divided into seven compartments suitable for holding various sizes of papers, etc.

Gasoline Lantern. (Refer to sec. D, Lighting equipment.)

Gasoline Lantern Cartons. (Refer to sec. D, Lighting equipment.)

Knapsack (Packsack). (Refer to sec. J, Back-packing equipment.)

Bed Tarp, Canvas. (Index No. MSF-350.)

While the kapok sleeping bag has obviated to a great extent the necessity for canvas bed tarps, there still remains some need for this item. The specification provides a tarp approximately 6 feet wide by 14 feet in length, hemmed on both ends and provided with grommets at each corner. Either white or colored 12-ounce duck is used.

Cotton Bed Blanket. (Index No. MSF-45-S.)

Federal specification No. DDD-B-421a, type 1, as amended, will provide a satisfactory cotton blanket for use in forest-protective work.

Wool Bed Blanket. (Index No. MSF-44-S.)

Federal specification DDD-B-421a, type 2, as amended, will provide a wool bed blanket suitable to the requirements of forest-protective work.

Kapok Sleeping Bag. (Index No. MSF-34. R1-P.)

For use by fire fighters and others in place of blankets, particularly in localities where transportation is a problem (fig. E-15). Provides a reasonably warm and comfortable bed. Fairly waterproof. Consists of an outer covering with carrying straps and head flap, a kapok mattress, and a slip-on mattress cover. Size 72 by 78 inches. Weight complete, ap-

proximately 12 pounds. Outer covering made of waterproof duck; mattress covering and slip-on cover of very light duck. All coverings fast-colored oliver drab. Material is sufficiently strong to withstand years of hard use. Inner sheets and mattress easily removed for cleaning. Kapok mattress should never be laundered. It should always be renovated by

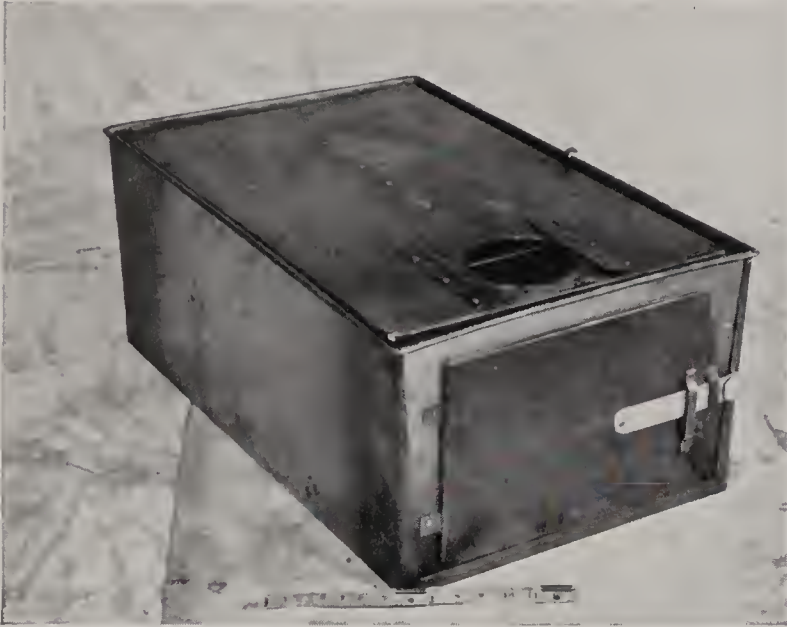


FIGURE E-16.—Kimmel camp stove nested for transporting.

a suitable dry-cleaning method. Rest of bag can be laundered.

Kimmel Camp Stove. (Index No. MSF-331.)

A sturdily constructed lightweight nestable camp stove for fire-control work and other Forest Service camp requirements (figs. E-16, E-17). The stovepipe and collars are nested within the oven and the oven is nested within the firebox, making a package approximately 28 by 18 by 12 inches when packed. The top of the firebox provides a cooking surface of approximately 18 by 22 inches. The inside of the oven is approximately 20 by 17 by 6½ inches in height. The entire stove is constructed of 24 gage material and the firebox is reinforced with heavier-gage ribs and top braces. Entire unit weighs approximately 65 pounds.

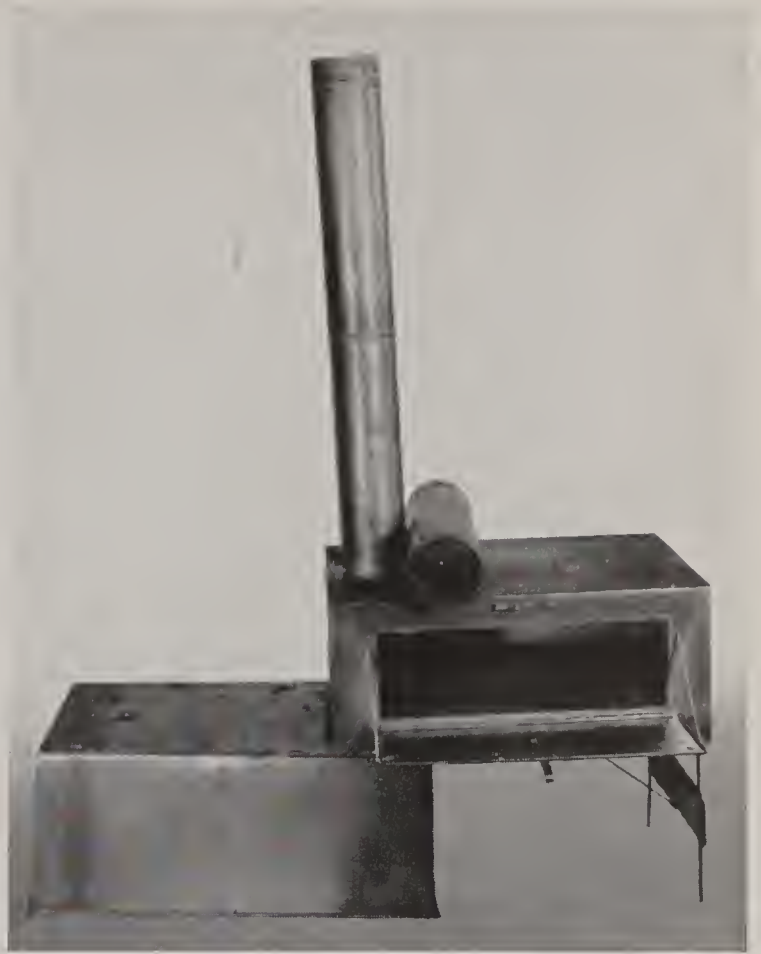


FIGURE E-17.—Kimmel camp stove ready for use.

Range, Field, Liquid Gas. (Index No. 289. R5-X.)

Where transportation facilities permit, liquid-gas ranges are a valuable device (fig. E-18, E-19). Various types have been developed in the California Region, using standard regulators and burners. The fuel cost is low and eliminates wood-cutting crews. Cooking facilities are improved and clean camp kitchens are the rule. These ranges use the standard commercial type of liquid gas, such as Flamo, Shellane, etc. The type of range used is provided with a detachable oven section and with as many 2-foot square five-burner cooking units as may be desired.

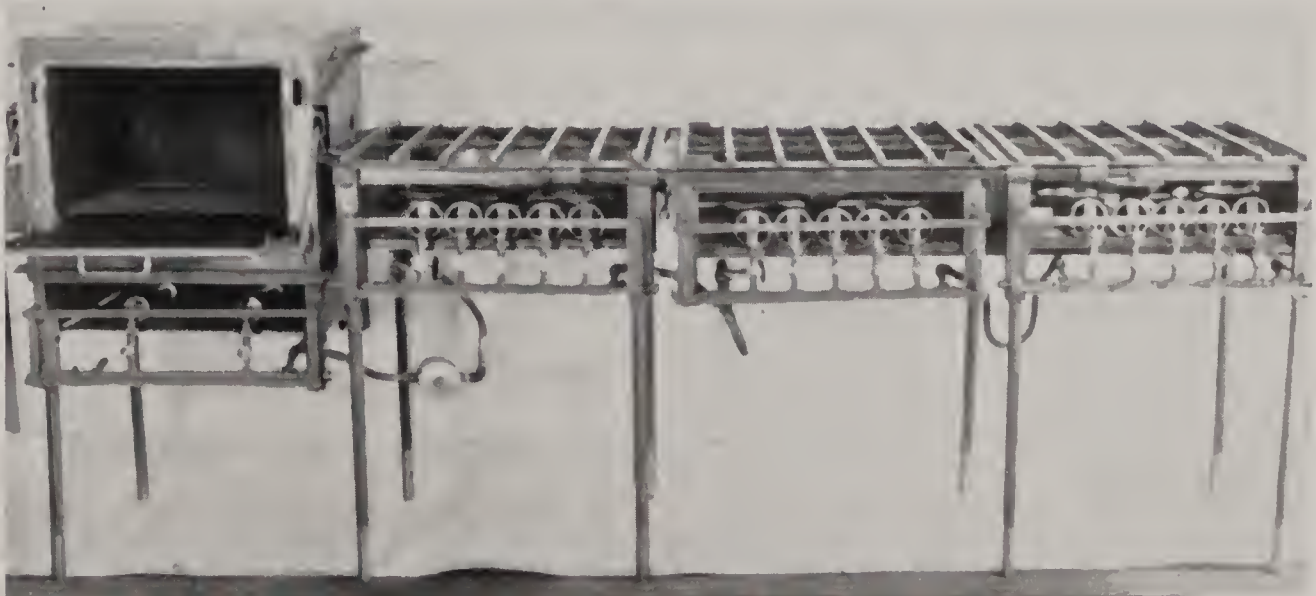


FIGURE E-18.—Liquid-gas range with three five-burner units and oven ready for use.

Canvas, Roll-up Table Top. (Index No. 343-S.)

A very satisfactory type of roll-up table top can be manufactured from canvas and lath

according to the strength of the canvas material used, usually about 3 to 4 inches apart. Figure E-21 illustrates clearly the manner of construction.

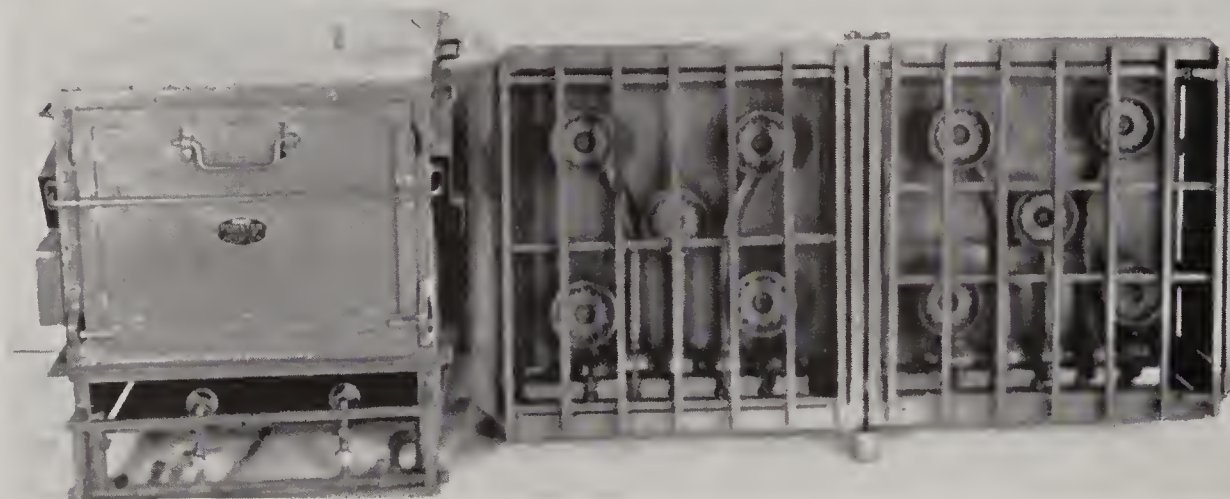


FIGURE E-19.—Liquid-gas range with two five-burner units and oven knocked down for transporting.

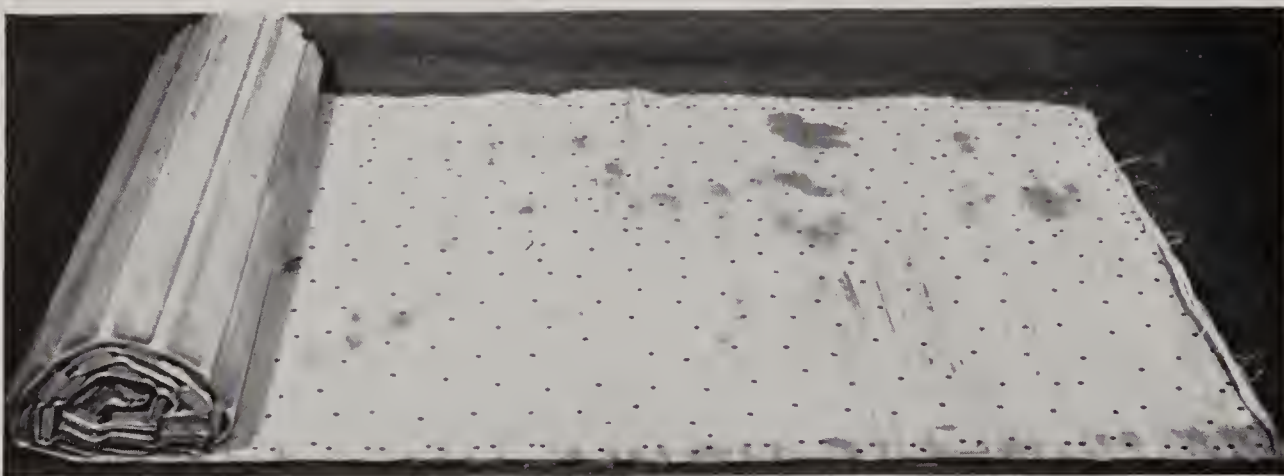


FIGURE E-20.—Roll-up table top.



FIGURE E-21.—Table-top ration box.

(fig. E-20). The canvas is cut to the length of table desired and approximately 2 inches wider than the length of a standard lath. One inch of the edges is then folded under and the canvas securely tacked to lath sticks laid side by side, spaced approximately $\frac{3}{4}$ to 1 inch apart. The tacks used should have large heads and be of sufficient length to go through the lath and clinch slightly. The tacks should be spaced

Table-Top Ration Box. (Index No. 344.)

Region 1 uses a combination table-top ration box in which to transport fire rations (fig. E-21). The box provides between 3 and 4 cubic feet of space and is held together with ordinary metal box strapping. After the rations reach the fire camp or other location where they are to be used, the box can easily be



FIGURE E-22.—Folding fire-camp table.

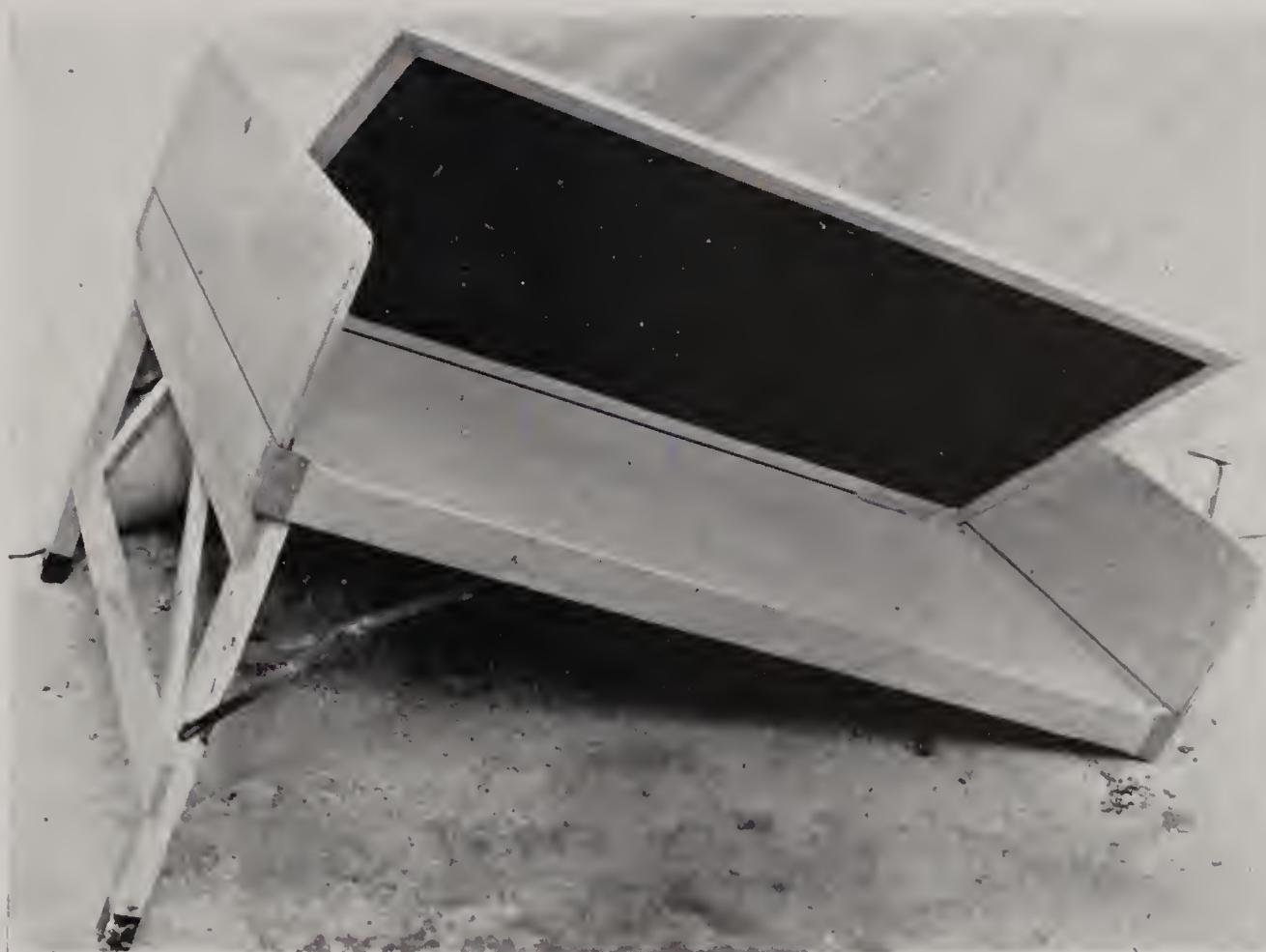


FIGURE E-23.—Folding camp-boss table.

opened and made into a table top approximately 30 inches wide and 7 feet long.

Folding Fire-Camp Table, Mediumweight.
(Index No. 341-2-S. R5-X.)

Another type of folding fire-camp table which has proved quite satisfactory where

transportation is not a problem is the solid-top type having only folding legs, as illustrated in figure E-22. The manner of constructing this table is so simple that it may be readily ascertained from the illustration. The leg braces are made of strap iron, hinged at the



FIGURE E-24.—Folding fire-camp table, knocked down.

center to permit folding. The brace is then placed in a piece of ordinary iron pipe before assembling. This pipe then serves as a lock over the hinged joint when the table is in use. The lower end of the brace has a square offset to retain the pipe in a proper location for holding the joint solid. Any grade of material may be used in the table, and it can be constructed of any size to fit local conditions.

Folding Camp-Boss Table. (Index No. 342-1-S. R5-X.)

Figure E-23 illustrates a very efficient type of folding camp-boss or fire-boss table. The dimensions of the table illustrated are approximately 3 by 6 feet by 30 inches high. It is provided with a blackboard which is approxi-

mately 6 feet in length by 30 inches in height. The blackboard is held in an upright position by fastening to the two end boards of the table with any sort of suitable hook fastener. The table is constructed of $\frac{3}{4}$ -inch bracing material, plywood sideboards, blackboard, and table top, and the legs are made of $1\frac{1}{2}$ -inch square stock. The entire table folds together, making a lightweight, flat package approximately 3 by 6 feet by 4 inches.

Folding Fire-Camp Table, Lightweight.
(Index No. 341-1-S. R5-X.)

Region 5 uses a folding fire-camp table, the top of which is made up of three 1- by 12-inch boards 6 feet long. These boards are hinged together so that they fold up accordion fashion, one on top of the other. They are held flat when in use by a rabbeted end piece as shown in the illustration. The two leg sets may be folded into a compact bundle by removing four wing nuts. Most of the construction details are readily obtainable from the two views of the table herein illustrated (figs. E-24, E-25). In some instances dowel pins have been used to hold the table top in place in lieu of the rabbeted end pieces. The entire table, when knocked down, makes a very lightweight, compact package 6 feet in length.

Fire-Camp Directional Sign. (Index No. MSF-327. SDO-P.)

A new type of reflector sign has been designed and will be provided to Forest Service units upon requisition to the Supply Depot. The sign consists of a reversible red arrow with an aluminum-foil reflector, faced with ruby-colored Cellophane. This arrangement provides a sign which will reflect light from approaching head lamps quite distinctly at night. In addition to the reflector arrow, there is provided a space for writing in the name of the fire or camp, and the distance thereto.

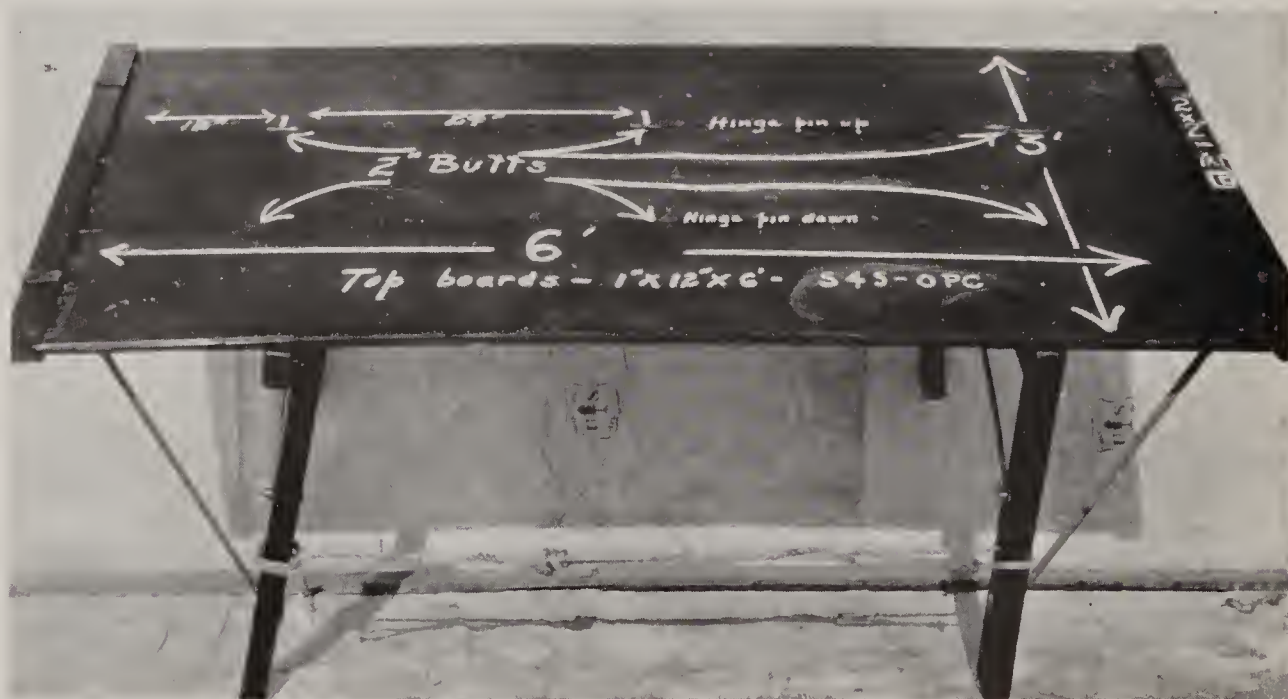


FIGURE E-25.—Folding fire-camp table.

SECTION F
SUBSISTENCE SUPPLIES

SUBSISTENCE SUPPLIES

Along with the need for nested mess outfits, special fire-fighting tools, and so forth, there is the need for special ration lists, rations, and facilities for quickly and adequately subsisting the men who combat forest fires; the more difficult the transportation problem, the greater the need. An inadequately subsisted fire crew

With the items listed it is unnecessary to carry a cooking outfit. The bread can serve for a coffee pot, coffee being the only item in the ration not ready prepared to eat. Gross weight is approximately 5 pounds. The rations are put up in Spokane by the Forest Service and packed 24 to the case for shipment.

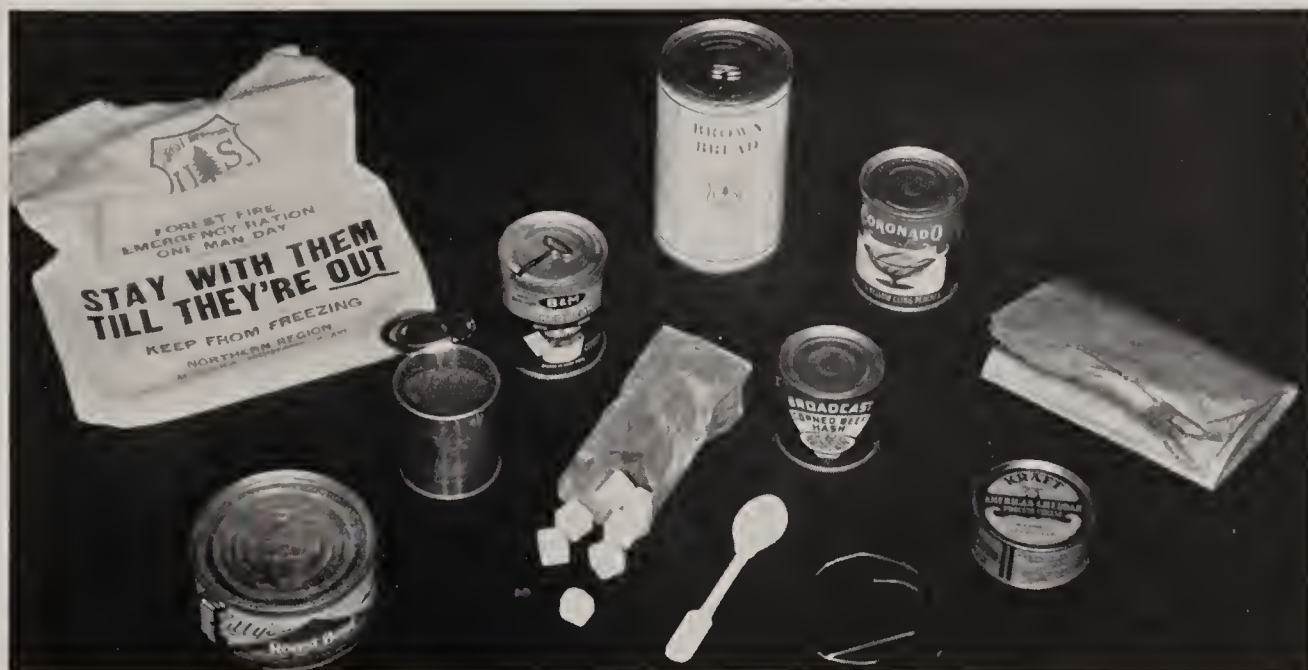


FIGURE F-1.—Contents of 1-day emergency ration—western type.

or a delay in the kitchen serving line can very easily, and frequently does, result in the loss of a hundred man-hours of work on the fire line, often during the time of day best suited to fighting fire.

The ensuing data provide an insight into some of the various methods employed in subsisting fire crews and fire-protection forces. References are provided for those who wish to obtain further detailed information regarding those subjects which cannot be fully described or contained herein.

One-Man Day Emergency Ration, Western Type. (R1-X.)

The western, or Region 1 type, 1-day emergency ration (fig. F-1) is used quite extensively throughout the western Forest Service Regions for both fire guards and emergency fire crews. The ration contains:

- | | |
|----------------------------------|------------------------------|
| 1 Roast beef, 12-ounce can. | 1 Coffee, 2-ounce can. |
| 1 Corned beef hash, 6-ounce can. | 1 Fruit, 8-ounce can. |
| 1 Pork and beans, 8-ounce can. | 1 Brown bread, 16-ounce can. |
| 1 Cheddar cheese, 3½-ounce can. | 1 Substantial paper spoon. |
| 1 Bag sugar, 8 lumps. | 1 Piece wire. |
| | 1 Cloth sack (container). |

One-Man Day Emergency Ration—Eastern Type.

Where transportation is not a grave problem, the following 1-day ration provides wholesome sustenance (fig. F-2). It is designed for use

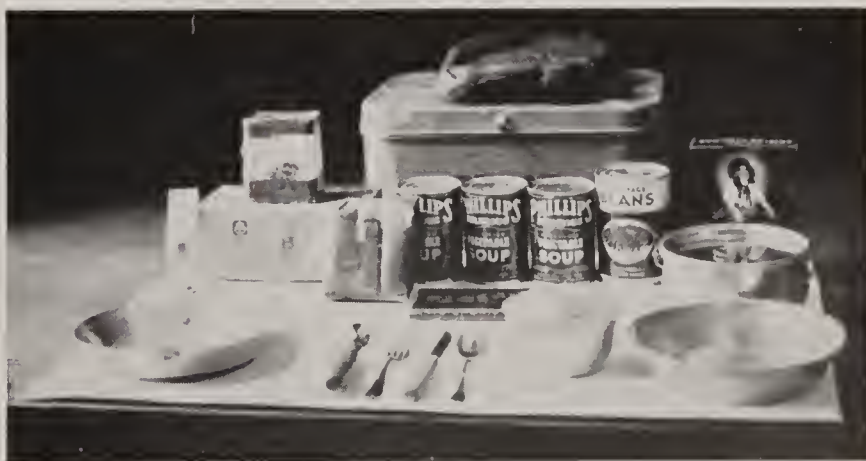


FIGURE F-2.—One-man day ration—eastern type.

where auto and truck are the principal transportation means; however, it is adaptable to horse transportation, too, but considered too heavy for back-packing and foot travel. The ration consists of:

- 3 Vegetable soup, 10-ounce can.

1 Corned beef, 12-ounce can.

1 Baked beans, 12-ounce can.

1 Coffee, 4-ounce package.
- 1 Zweiback, 6-ounce package.

1 Raisins, 15-ounce package.

1 Milk chocolate, 4-ounce bar.

1 Outfit, 1-man mess.

The contents of the ration except coffee are edible without further cooking but are much more savory if heated—thus the mess outfit.

In certain eastern localities the ration is packed complete with mess outfit, in a small, metal, bread-box type of container measuring approximately 6½ by 9½ by 13½ inches over all. Gross weight of ration, mess outfit, and container is about 11 pounds.

Thirty-Man, 2-Day, Fire-Crew Emergency Ration. (R1-X.)

Region 1 has designed a special fire-crew ration which is put up in 30-man, 2-day units. Each unit provides sufficient food for balanced subsistence of 30 to 35 men for 2 days. A



FIGURE F-3.—Thirty-man, 2-day emergency ration packed for transporting.

unit contains a first and second supper, a first and second breakfast, and two sack lunches (midday meals). The entire ration is packed in six wooden boxes ready for horse transportation without further cargoeing. Each box contains a full 30-man meal and is plainly labeled upon the outside. The purpose of the ration is to expedite the subsisting of fire crews during the first 2 days, after which regular stock supplies are furnished if further need exists. Each box contains simple written instructions for preparing the meal so that inexperienced cooks may efficiently serve the meal or prepare the individual sack lunches, as the case may be. The ration is standard throughout Region 1, and is used to some extent in Regions 4 and 6. The method of boxing, label-

ing, and the weight of the ration unit ready for transporting is shown in figure F-3.

Fire-Camp Cookbook. (R1-X.)

A fire-camp cookbook has been written for use with standard fire-crew rations, especially the 30-man, 2-day ration, and standard nested mess outfits. The cookbook outlines the use of the various standard items of mess equipment, explains how to serve the various standard fire rations, how to prepare individual sack lunches, how to lay out an efficient fire-camp kitchen, and suggestions on kitchen crew organization. It also lists the contents of the various types of ready-prepared rations and furnishes a list of stock subsistence items which may be requisitioned for fire-camp use.

The following example is extracted from the fire-camp cookbook. It gives the contents of the first supper contained in the 30-man, 2-day ration and also the method of preparation:

FIRST SUPPER

Packed in boxes marked "First supper."

This meal requires about 1½ hours to prepare and must be the first hot meal served in camp, unless otherwise instructed by the foreman. Upon notice from the foreman that this meal is to be served, the cook should get busy on its preparation while the flunkies unpack the mess equipment and wipe all the tableware and dishes with clean, dry towels. The cooking utensils should be washed and rinsed before using, if sufficient time is available.

MENU		
Meat		
Beef Stew		
Coffee		
Dessert		
Canned Fruit		
Butter	Bread	Jam
Sugar		Milk
Salt		Pepper

The meal will consist of the following articles:		
Stew	14 cans No. 2	
Roast beef	6 cans No. 2	
Tomatoes	3 cans No. 2½	
Carrots	3 cans No. 2½	
Peas	4 cans No. 2	
Bread (sliced)	8 1-pound loaves	
Butter	2 pounds	
Sugar, cube	1 3-pound carton	
Peaches	6 cans No. 2½	
Jam	3 cans No. 2	
Coffee	1 3-pound can	
Milk	4 cans	
Pepper	1 2-ounce can	
Salt	1 ½-pound can (slip-top)	

To prepare this meal, proceed as follows:

Place large washboiler (or No. 1), half full of water, on fire to furnish supply of hot water, and to use as double boiler.

RECIPES

Beef Stew

14 cans stew. 3 cans carrots.
 6 cans roast beef. 4 cans peas.
 3 cans tomatoes. salt and pepper.

Mix the stew, tomatoes, and carrots in the large round boiler (or No. 4). Place this boiler in the large washboiler (No. 1) previously filled half full of water, and let simmer, stirring often. This will make a double boiler. About $\frac{1}{2}$ hour before serving time add the roast beef and peas. Season to taste with pepper and salt. Keep in boiling water until ready to serve. Serve very hot. **This cannot burn or scorch if you follow these instructions.**

Coffee

Fill the two No. 3 boilers to within 4 inches of the top with fresh (cold) water, add $4\frac{1}{2}$ level tincupfuls of coffee to each boiler, cover, place on fire, and bring slowly to a boil. As soon as it boils remove from fire and add 1 cupful of cold water to settle grounds. Keep in warm place until ready to serve. *Do not let it simmer.*

Open the fruit, jam, butter, and milk. Slice bread. Set out butter in pudding dishes. Set out fruit, jam, bread, salt, pepper, sugar.

Always have flunkies serve liquids and hot food-stuffs to men in order to properly apportion food and to prevent unnecessary delay.

Thirty-Man, Special-Travel, Spike-Camp Emergency Lunch. (R1-X.)

A special emergency lunch designed for use where a more substantial meal is needed than that provided by the regular individual sack lunch, and where serving time is an important element or transporting of mess equipment a problem. The entire meal can be prepared and served, including hot coffee, in about 45 minutes and is ample for 30 to 35 men. No dishes or mess equipment of any kind are necessary. The box container makes up into a 7-foot, serving-table top and provides slicing boards (see index 344 sec. E). The ration is sufficiently substantial and palatable to subsist small spike-camp crews for periods of 2 or 3 days in emergencies. It can also be made up into individual sack lunches, but is best adapted to serving as a regular meal.

The following extract from the fire-camp cookbook describes the contents of the emergency lunch:

THIRTY-MAN, SPECIAL-TRAVEL, SPIKE-CAMP EMERGENCY LUNCH

To be packed in the standard, knockdown, table-top type ration box:

Items	Amount	Items	Amount
Ham, canned...	5-6 pounds.	Spoons, dessert...	4.
Sandwich spread, canned.	4-5 pounds.	Knives or paddles (for spreading).	3.
Butter, canned...	2 pounds.	Knife, slicing...	1.
Jam, canned, No. 2	3 cans.	Can openers...	2.
Cheese, canned...	2 pounds.	Dippers, tin...	1.
Bread, sliced ¹ ...	10 loaves.	Brush, butter...	1.
Coffee, canned...	3 pounds.	Plates, paper, deep	36.
Milk...	4 cans.	Spoons, paper, long	36.
Sugar, cube...	1 pound.	Cups, paper, large	36.
Mustard, 4-ounce jar.	1 jar.	Bags, paper, lunch	36.
Pickles, dill, No. 2 $\frac{1}{2}$ can.	2 cans.	Sacks, flour, large	2.
Fruit, 8-ounce cans	30 cans.	Matches, safety	1 box.
Fruit cake...	10 pounds.	Paper, wrapping	10 feet.
Can, coffee, with bail, 6-gallon.	1.	Potchain and S-hooks.	1.
		Instructions for serving.	1.

¹ This lunch will be furnished with fresh bread unless requisitioned "for storage." Four 6-ounce packages zwieback and six 1-pound cans of brown bread will then be substituted for the fresh bread.

The primary purpose of this lunch is to facilitate the feeding of fire crews while en route to fires, emergency meals on reaching fire and when crew is needed in action, in out-of-the-way spike camps, etc. It is so designed that it can be used for preparing sack lunches (singles for 30 men) as well. This lunch should be used only for such emergencies and not for regular sack-lunch or meal purposes.

Thirty - Man Aerial Delivery Ration. (R1-X.)

This ration is very similar in design to the 30-man, special-travel, spike-camp emergency lunch. The primary purpose of this particular ration is the subsisting of men engaged in fire fighting in remote areas where transportation is a difficult problem. The ration is so designed that it is possible to subsist men for a period of several days if necessary without the use of mess equipment. The foodstuff contained is ready prepared except for coffee for which a boiler is provided in each ration. One ration is sufficient to subsist from 30 to 35 men providing a full-sized meal. When packed for aerial delivery (dropping from plane to ground), the ration consists of four bundles cargoed in lightweight canvas (fig. F-4). The heaviest bundle weighs less than 65 pounds. This particular ration has been used successfully for one full season.

Guard Rations. (R1-X.)

Region 1 has designed a series of guard-ration units for use in subsisting fire guards, lookouts, and small crews at outlying stations. The subsistence supplies contained in each unit are balanced to provide adequate subsistence for a given number of man-days. All canned foods contained therein are of the smaller sizes in order to avoid waste. Units of the following sizes are used:

A-30—30 man-day ration. C-60—60 man-day ration.
 B-45—45 man-day ration. D-75—75 man-day ration.

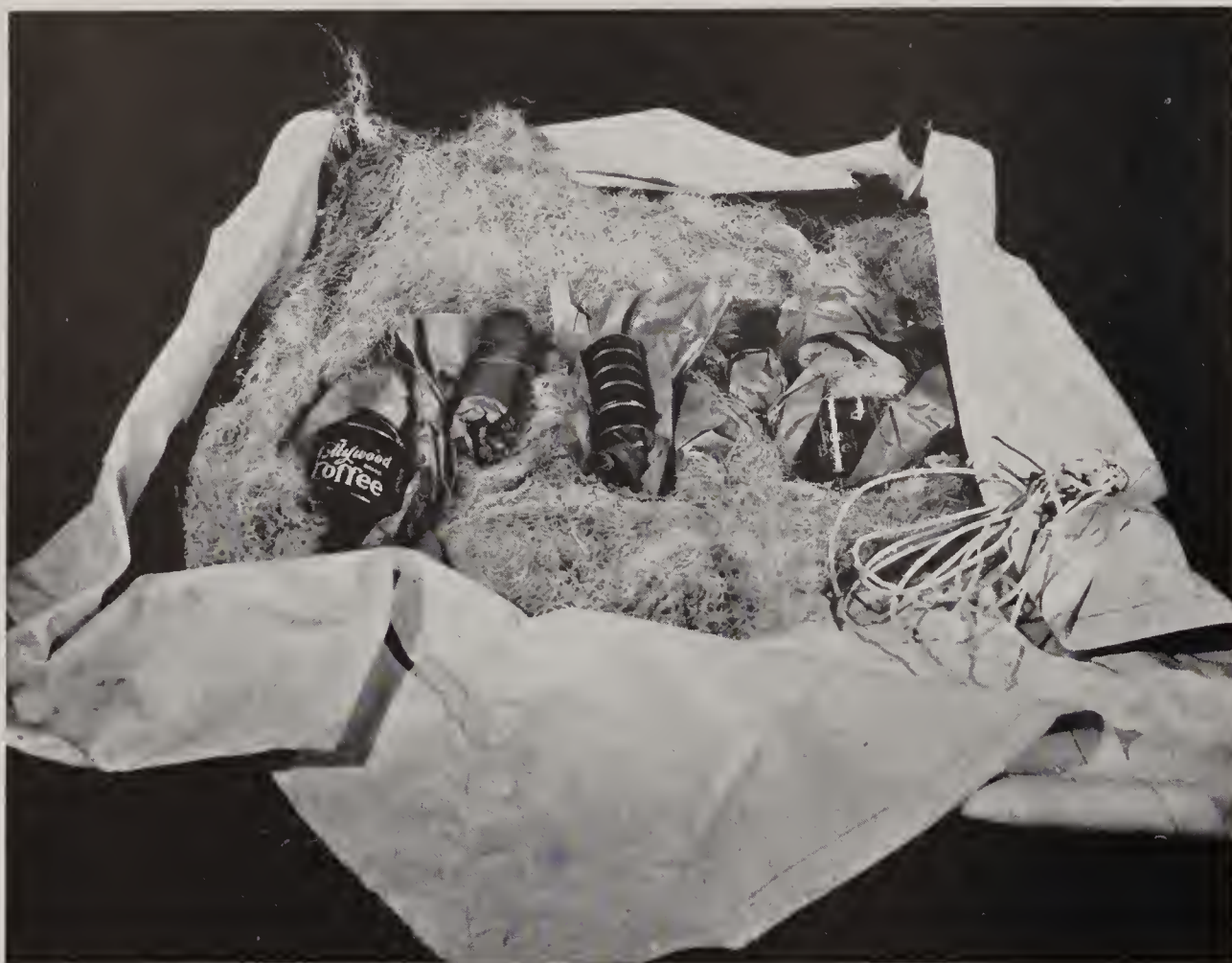


FIGURE F-4.—Showing method of packing aerial delivery ration.



FIGURE F-5.—B-45 ration.

The B-45 ration is made up of the following listed items and is illustrated in figure F-5:

Standard ration list—B-45

45 MAN-DAY RATION

(For use at protection and other small camps)

Item	Contents	Unit	Units
			Number
Flour, white	10 pounds	Sack	4
Soda	1 pound	Package	1
Baking powder	do	do	1
Rolled oats	3 pounds	Sack	1
Cornstarch	1 pound	Package	1
Rice	3 pounds	Sack	1
Ham, ¼-size	2 pounds	Can	8
Roast beef	12 ounces	do	8
Salmon	½ pound	do	4
Shortening	2 pounds	do	3
Beef stew	do	No. 2 can	2
Frankfurters	11 ounces	Can	3
Butter	1 pound	do	8
Milk, tall	14½ ounces	do	36
Cheese	3½ ounces	do	10
Coffee	1 pound	do	4
Cocoa	½ pound	do	1
Sugar, white	5 pounds	Sack	4
Syrup	2½ pounds	Can	2
Beans, lima	3 pounds	Sack	
Beans, navy	do	do	1
Beans, red	do	do	1
Macaroni	8 ounces	Package	1
Tapioca	do	do	1
Corn	11 ounces	Can	3
Do	do	No. 2 can	4
Carrots	8 ounces	Can	3
Peas	11 ounces	do	9
Beans, cut	8 ounces	do	6
Pork and beans	9 ounces	do	8
Sauerkraut	8 ounces	do	3
Spinach	do	do	3
Sweet potatoes	do	No. 2½ can	4
Tomatoes	15 ounces	Can	6
Apples, pie	do	No. 2½ can	2
Grapefruit	8 ounces	Can	14
Peaches	do	do	14
Pears	do	do	14
Apricot jam	20 ounces	do	2
Strawberry jam	do	do	4
Peach jam	do	do	2
Apricots, dry	2½ pounds	do	1
Prunes, dry	do	do	1
Raisins	15 ounces	Package	3
Catsup	½ pint	Bottle	2
Pickles	10 ounces	Can	3
Vinegar	1 pint	Bottle	1
Mustard, prepared	9 ounces	Jar	1
Salt	3 pounds	Sack	1
Soap, laundry	8 ounces	Bar	4
Soap, hand	4 ounces	do	3
Candles	do	Each	12

These items are to be added by the forest when rations are packed out, if no stock is available at destinations: Bacon, 12 pounds; potatoes, 55 pounds; eggs, one-fourth case; onions, 5 pounds; yeast, 1 package; matches, 3 boxes; tea, black, 1 only, ¼-pound package; vanilla extract, 1 only, 4-ounce bottle; pepper, black, 1 only, 2-ounce can; lemon extract, 1 only, 4-ounce bottle.

RATION LIST AND TABLES

The following fire-crew ration list and ration tables work out quite efficiently when used as guides in preparing or ordering subsistence supplies for fire crews. The fire-crew ration list is worked out on the basis of 10-man units, unit 1 being for 10 men, unit 2 for 20 men, etc., for 1 day. The ration tables are worked out on the basis of one man for 1 day:

Fire-crew rate on list for units for 10 men

(To be used by camp bosses ordering and merchants furnishing food supplies)

Article	Unit	Quantity 1 for—				
		1 unit	2 units	3 units	4 units	5 units
Fresh meat	Pound	10	20	30	40	50
Ham	do	4	8	12	16	20
Bacon	do	2	4	6	8	10
Bread	Loaf, large	9	18	27	36	45
Shortening compound	Can	1	2	3	4	5
Sugar	Pound	4	8	12	16	20
Eggs	Dozen	3	6	9	12	15
Coffee, ground	Pound	2	4	6	8	10
Milk, canned	Large size	4	8	12	16	20
Butter	Pound	1½	3	4½	6	7½
Prunes, dried	do	2	2	3	3	3
Peaches	Quart can	2	4	6	8	10
Apricots	do	1	2	3	4	5
Rice	Pound	2	4	6	8	10
Beans, pink	do	3	6	9	12	15
Potatoes	do	10	20	30	40	50
Onions	do	1	2	3	4	5
Tomatoes, solid pack	Quart can	3	6	9	12	15
Macaroni	Pound	1	2	3	4	5
Cheese	do	2	4	6	8	10
Minced ham	do	2	4	6	8	10
Pickles	Quart	1	2	3	4	5
Salt	Pound	1	1	1	2	2
Pepper	Ounce	2	2	4	4	4
Dish towels	Number	3	3	5	5	5
Hand towels	do	3	3	4	4	4
Ivory soap	Bars	2	3	4	4	4
Matches, boxed	Boxes, large	1	2	3	4	5
Paper bags, size No. 8	Number	12	24	36	48	60
Jam, assorted, in cans	Quart	2	4	6	8	10
Tomato juice	15-ounce can					2 48

1 10 men, 1 day=1 unit; 20 men, 1 day=2 units; 30 men, 1 day=3 units; 40 men, 1 day=4 units; 50 men, 1 day=5 units; 20 men, 2 days=4 units.
2 Cans.

After first order, officer in charge of camp should, of course, order food supplies as needed, using the table as a guide, substituting vegetables where and when possible to offset heavy foods.

Combination ration table—1 man for 1 day

Balanced ration for 1 man for 1 day 1	Amount 2	Equivalent substitutes for staple items in column 1
Fresh meat	1.50 pounds	Bacon 0.7 pound, ham 0.9 pound, canned meat 1.2 pounds, eggs 12, beans 1 pound.
Cheese	0.06 pound	Sweet chocolate 0.06 pound, fresh meat 0.12 pound.
Beans	0.2 pound	Rice, hominy, or lentils 0.2 pound, baked beans ½ can or 0.5 pound.
Bread	1 pound	Flour 0.8 pound, crackers 0.7 pound, corn meal 0.8 pound, macaroni 0.7 pound.
Baking powder	0.04 pound	Yeast (for light bread) ½ cake, soda (for sour dough) 0.01 ounce.
Oatmeal	0.15 pound	Cream of wheat, corn meal, rice, corn flakes 0.17 pound.
Potatoes	1 pound	Rice, hominy, or beans 0.25 pound, evaporated potatoes 0.15 pound.
Fresh vegetables	0.35 pound	Peas, corn ½ can or 0.25 pound, tomatoes ½ can or 0.9 pound, dried vegetables 0.07 pound.
Dried fruit	0.1 pound	Canned fruit ¼ can or 0.45 pound, fresh fruit 0.5 pound, raisins 0.10 pound.
Canned fruit	¼ can	Jam or apple butter ½ can; dried fruit 0.10 pound.
Coffee	0.13 pound	Tea 0.03 pound, cocoa 0.08 pound.
Sugar	0.4 pound	
Milk (evaporated)	½ can	Fresh milk ¾ pint, powdered milk ¾ ounce.
Butter	0.12 pound	Peanut butter 0.12 pound.
Lard	0.1 pound	Bacon grease 0.10 pound.
Salt	0.04 pound	
Pepper	0.06 ounce	Red pepper 0.0015 pound.
Sirup*	½ pint	
Pickles*	½ pint	Vinegar, ½ pint.

Footnotes at end of table.

Combination ration table—1 man for 1 day—Con.

Balanced ration for 1 man for 1 day	Amount	Equivalent substitutes for staple items in column 1
Cinnamon*-----	0.04 ounce----	Ginger, nutmeg, cloves, mustard, or allspice 1/25 ounce. Tapioca, 0.02 pound.
Extracts*-----	0.03 ounce----	
Cornstarch*-----	0.02 pound----	
Matches-----	-----	
Soap-----	-----	Lighter ration obtained by selecting the lighter substitutes.
Total weight--	6 pounds-----	

¹ Items marked with an asterisk (*) are essential only in permanent or moderately large camps.
² All weights given are exclusive of cans or other containers.

Simple ration table—1 man for 1 day

Supplies ¹	1-day ration	Supplies	1-day ration
Fresh meat, including fish (a).	1 pound.	Canned fruit (g)---	0.25 can.
Cured meat or canned meat (b).	0.40 pound.	Sugar-----	0.40 pound.
Cheese-----	0.08 pound.	Coffee (h) -----	0.12 pound.
Bread, flour or crackers (c).	0.80 pound.	Milk, evaporated (i).	0.30 can.
Baking powder or yeast cakes.	0.04 pound.	Butter (j)-----	0.10 pound.
Cereals or corn meal.	0.15 pound.	Lard (k)-----	0.10 pound.
Potatoes or other fresh vegetables (d).	1.20 pounds.	Salt-----	0.04 pound.
Rice or beans-----	0.20 pound.	Pepper-----	0.08 ounce.
Canned vegetables (e).	0.15 can.	Sirup*-----	0.01 gallon.
Dried fruit (f)-----	0.10 pound.	Spices*-----	0.04 ounce.
		Flavoring extracts*.	0.04 ounce.
		Pickles-----	0.03 quart.
		Vinegar*-----	0.01 quart.
		Soap and matches--	
		Total weight---	6 pounds.

¹ Items marked with an asterisk (*) are essential only in large or permanent camps.

SUBSTITUTIONS WHICH MAY BE MADE

- (a) 8 eggs=1 pound fresh meat.
- (b) 2 pounds fresh meat=1 pound cured meat.

- (c) 1 pound corn meal or 1 pound macaroni=1 pound flour.
- (d) 1 pound dried vegetables=5 pounds fresh vegetables.
- (e) 1/2 pound dried or 1 pound fresh vegetables=1/2 can (standard size).
- (f) 5 pounds fresh fruit=1 pound dried fruit.
- (g) 1/2 pound dried fruit=1 No. 2 can canned fruit.
- (h) 1/4 pound tea or 5/8 pound cocoa=1 pound coffee.
- (i) 1 quart fresh milk=1 tall can evaporated milk.
- (j) 1 1/2 pounds peanut butter=1 pound creamery butter.
- (k) 1 pound bacon grease=1 pound lard.

Bags, Cloth, Lunch. (Index No. 247-60-S.)

(Refer to sec. E, Camp equipment, for the specification covering this item.)
The specification provided will secure a cloth lunch bag suitable for packaging individual lunches on the fire line or elsewhere.

Bags, Cellophane, Lunch. (Index No. MSF-247-54-S.)

(Refer to sec. E, Camp equipment, for the specification covering this item.)
The Cellophane lunch bag, while somewhat more expensive than the ordinary kraft-paper bag, is far superior in both moisture-retaining and strength qualities. Lunches put up in this bag will remain moist and edible for a period of 24 hours. Also, jam and other moist substances will not saturate the bag causing it to become messed up. The specification given is for a standard size, Cellophane bag which should be obtainable from any paper-bag dealer.

SECTION G
MEDICINE KITS AND FIRST-AID EQUIPMENT

SECTION G

MEDICINE KITS AND FIRST-AID EQUIPMENT

Medicine-Kit Container, Large Size. (Index No. MSF-205-1.)

This container is designed for use with large crews (50 men or more) which are retained for long periods of employment, usually throughout the season. It is made of 26-gage galvanized iron and constructed in the form of a small suitcase. The dimensions are 12 by 16 inches by 4 inches deep.

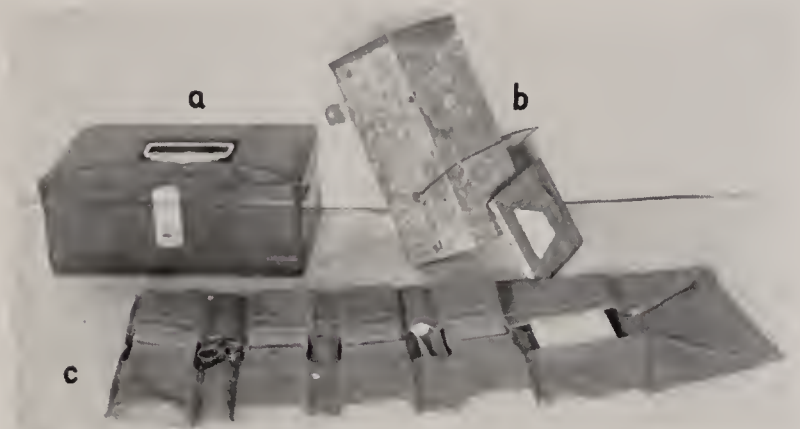


FIGURE G-1.—(a) Medium size medicine-kit container; (b), wall or truck cab container; (c), canvas roll-up, first-aid kit.

Medicine-Kit Container, Medium Size. (Index No. MSF-205-2.)

This container is also designed for use with large crews where the period of employment does not continue over an extended length of time. It is particularly adapted to use with fire crews regardless of size since its capacity permits including sufficient medical supplies for this purpose. It is constructed in the form

of a cash box with a lock fastener and with an inset handle at the top center. The dimensions of the box are approximately 7½ by 11 inches by 4 inches in depth. It is finished with dark-green enamel (fig. G-1).

Wall or Truck Cab First-Aid Kit Container. (Index No. MSF-210. SDO-P.)

This container is designed particularly for use in truck cabs where it may be fastened to the back of the cab with four supporting brackets or ears. It is also adaptable to use in buildings where it may be fastened in any convenient location to the wall. The container is constructed of 26-gage galvanized iron and is both moisture- and dust-proof. The dimensions are 4 by 4 by 9½ inches, which permits the use of canvas roll-up first-aid kit (index No. MSF-210-1).

Canvas Roll-Up First-Aid Kit. (Index No. MSF-210-1. SDO-P.)

The roll-up first-aid kit consists of a light-weight canvas container into which is constructed a series of pockets which contain the first-aid items. Forest Service units may procure this outfit complete from the Supply Depot. It is designed especially for use with the wall or truck cab container (index No. MSF-210). The kit contains the following items:

2 Triangular bandages.	1 ½-ounce tube Pyrol.
1 4-inch compress.	½ Ounce iodine or mer- curochrome.
4 2-inch compresses.	1 Pair tweezers.
16 1-inch adhesive com- presses.	1 Pair seissors.
10 Ammonia inhalants.	1 First-aid book.
1 Tourniquet.	

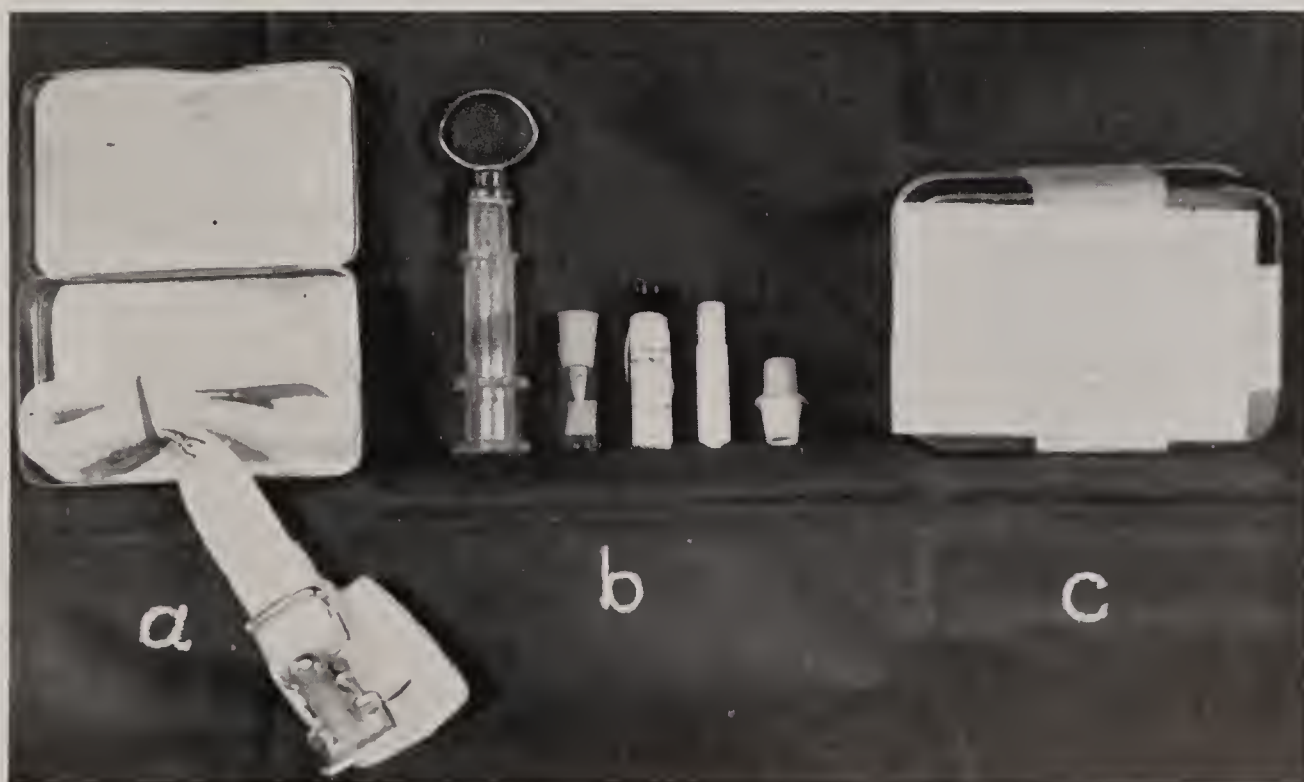


FIGURE G-2.—a. Snake-bite outfit container with tourniquet; b, contents of snake-bite outfit; c, individual-packet medicine kit.

Medicine Kit, Individual-Packet Size. (Index No. MSF-208. SDO-P.)

The individual size medicine kit is obtainable by Forest Service units through the Supply Depot (fig. G-2). It consists of the following items:

- | | |
|--|------------------------------------|
| 1 Tin container, $4\frac{5}{16}$ by $3\frac{1}{2}$ by $1\frac{1}{2}$ inches. | 1 Dozen aspirin tablets. |
| 2 Gauze bandages. | 1 Dozen cathartic pills. |
| 1 Roll adhesive tape, 1 inch by 1 yard. | $\frac{1}{4}$ Ounce mercurochrome. |
| 1 Dozen 5-grain boric acid tablets. | $\frac{1}{4}$ Ounce Unguentine. |
| | 3 Safety pins. |
| | 3 1-inch adhesive compresses. |

Medicine Kit, Snake-Bite Outfit. (Index No. MSF-209. SDO-P.)

Snake-bite outfits may be obtained by Forest Service units from the Supply Depot. The outfit consists of all the essentials necessary for the treatment of snake bites (fig. G-2). It is made up of the following items:

- | | |
|--|--|
| 1 Tin container approxi-
mately 4 by 2½ by 1
inches. | 1 Steel scalpel enclosed
in glass. |
| 1 Directions for use. | 1 Iodine swab. |
| 1 Glass suction pump. | 1 Small vial aromatic
spirits of ammonia. |
| 1 Small cotton tourniquet. | |

Medicine-Kit Contents. (Index No. 205-S.)

The following listed items and quantities of each are suggested for making up a large-crew size, emergency medicine kit. These items can be packed in the smaller of the two metal containers (index No. MSF-205-2).

- | | |
|---|--|
| 1 Container. | 1 Ounce petrolatum or petroleum jelly. |
| 1 Contents list. | 1 Dozen safety pins. |
| 1 First-aid book. | 1 Pair tweezers. |
| 1 Ounce Lysol. | 1 Pair small scissors. |
| 2 Ounces boric acid. | 2 1-ounce absorbent cotton. |
| 2 Ounces Unguentine, Pyrol, or equal. | 7 Gauze bandage, 2½ inch by 6 yard. |
| 1 Ounce aromatic spirits of ammonia. | 6 Gauze bandage, 3 inch by 6 yard. |
| 3 Drams oil of cloves. | 5 Gauze bandage, 3½ inch by 6 yard. |
| 3 Dozen aspirin tablets (3-grain). | 2 Gauze compresses. |
| 2 Dozen dysentery pills (dispense with care). | 1 Tourniquet, United States Army. |
| 75 Cathartic pills. | 1 Aluminum eye cup. |
| 1 Ounce mercurochrome or iodine. | 1 Snake-bite outfit (where required). |
| 6 1-inch by 1-yard adhesive tape. | 1 Poison-oak remedy (where required). |
| 24 1-inch adhesive compresses. | |
| 1 Jar Vicks Vapo-rub or equal (small). | |

Where exceptionally large crews are employed and for a considerable period of time, larger quantities of the foregoing items may be necessary. In such instances the large medicine-kit container (index No. MSF-205-1) is recommended. In addition to increasing the quantities of items already listed the following may be added:

- 1 Pound Epsom salts.
6 Ounces Hall's antiseptic cream salve.
1 Pint alcohol.

The first list of contents suggested is adequate to serve all purposes in connection with fire-control work where the outfits can be replenished after every two or three fires, as required. The larger container outfit is intended more for use with large crews (50 or more men) which are employed more or less continuously throughout the season.

Veterinary Medicine Kit. (Index No. 201-S.)

This kit is recommended for use with plow teams on fire duty and also with any horse or mule units in the field. The medicine included is for the treatment of such common ailments



FIGURE G-3.—Veterinary medicine kit.

as colic, blackwater, saddle and collar galls, calked feet, bruises, and wounds. The farrier's equipment is for replacing pulled shoes in the field.

The kit is comprised of a small wooden box, of a size and shape to hold the following items, and provided with a hinged lid and hasp. The box illustrated (fig. G-3) is 17 inches long, 8½ inches wide, and 8½ inches deep, inside dimensions.

- | | |
|---------------------------------------|----------------------------------|
| 1 Pint pine tar. | 1 Horseshoe, front. |
| 1 8-ounce bottle creolin. | 1 Can healing powder. |
| 1 8-ounce bottle spirits of
niter. | ½-pint colic remedy. |
| 1 Farrier's hammer. | 2 8-ounce bottles carron
oil. |
| 1 Pair farrier's nippers. | 1 Farrier's knife. |
| 1 Pound horseshoe nails. | 1 Farrier's rasp. |
| 1 Horseshoe, hind. | |

Shoe and nail sizes will be governed by size of horses to which kit is assigned.

SECTION H
GRINDING AND SHARPENING EQUIPMENT

SECTION H

GRINDING AND SHARPENING EQUIPMENT

Files. (Index No. MSF-128.)

Mill bastard flat files are used for sharpening axes, hoes, and other fire tools, except saws. For saws, a special crosscut saw file is used. The standard specification is intended to secure second-grade files, because in fire-suppression work many files are lost rather than worn out and the extra cost of first-grade files is not justified. The specification as written may be used to secure any size or shape file desired.

Ax Stone, Hand. (Index No. MSF-329.)

A fast-cutting, vitrified abrasive pocket stone, 3 inches in diameter and five-eighths of an inch thick, for honing the edges of axes and other cutting tools after grinding or filing. One side of stone is of coarse grit and the other side of fine grit.

Saw-Filing Outfit. (Index No. MSF-246.)

The standard specification provides for raker gage, cutter tooth setting gage, swaging hammer, and set block. The raker gage has malleable-iron frame, straight edge faced with tempered tool steel, and chilled plate for filing down rakes. The tooth gage is standard pattern, malleable-iron, spider type. The hammer is 8-ounce, cross peen, with 12-inch handle. The setting block is made of 1-inch octagon tool steel, 5 inches long, with one end beveled.

A light canvas bag approximately 6 by 14 inches, with drawstring is suggested as a container.

For illustration of the outfit refer to figure I-13, items Nos. 6, 7, 8, and 9, under section I, Hand tools.

Hand Power Bench Grinder. (Index No. MSF-158.)

The specification covers three types and sizes of grinders, thus providing a tool suited to the requirements of the various grinding jobs to be encountered. The specification is intended to provide a thoroughly dependable tool in each of the following types:

A. Heavy-duty, ball bearing: Grinding wheel 8 by 1½ inches. Two single-row, multiple-ball bearings on grinding wheel shaft. Cast-iron gear case. Weight 25 pounds.

B. Heavy-duty, plain bearing: Grinding wheel 7 by 1¼ inches. Cast-iron gear case. Weight 20 pounds.

C. Medium-duty, plain bearing: Grinding wheel 6 by 1 inch. Weight 12 pounds with cast-iron gear case, 8 pounds with aluminum-alloy gear case. (Case optional with manufacturer.)

Gear cases on types A and B are so designed that all bearings are contained in the same casting to insure proper bearing and gear alignment. All types are equipped with tool rests. The specification calls for grinding wheels of medium grit and hardness but changes may, of course, be made to meet purchasers' requirements.

Emery Grinder for Crosscut Saws. (RI-X.)

Consists of a ¼-horsepower electric motor to which is attached a 3½-foot flexible steel shaft encased in a flexible steel tube and culminating in a ½-inch mandrel on which the grinding wheel is mounted (fig. H-1). A straight handle



FIGURE H-1.—Crosscut-saw emery grinder.

is attached to the end of the steel tube just behind the grinding wheel to facilitate operation. The whole assembly is suspended from a standard barn-door track mounted on a frame which runs the length of the work table.

Two emery wheels, 4 by ¼ by ½ inch, Norton grade 100-M, are used. Each wheel is placed on the mandrel and beveled to a 45° angle with an emery-wheel dresser. For grinding cutting teeth the two wheels are mounted with the beveled edges facing so as to form a V-shaped groove, the paper labels first having been removed to permit a snug fit. Only one wheel is used for grinding raker teeth.

This machine has been found practical and very convenient for beveling cutting teeth, particularly on new saws, and for cutting out cen-

ters of raker teeth. The rough work only is done with the machine, the final sharpening being done with a file. Records kept over a period of time in Region 1 indicate a saving of 55 percent on files and 28.6 percent on time through the use of this machine.

Grinder, Portable Power. (Index No. MSF-159.)

Designed for use at fire camps and at stations where electric power is not available (figs. H-2, H-3). Weight of complete outfit, including shipping box, is approximately 225 pounds, but it can readily be disassembled for animal



FIGURE H-2.—Portable power grinder. Engine contained in carrier-type cover shown at left.

packing, the heaviest piece weighing about 80 pounds.

Grinder consists of a 1-horsepower air-cooled gasoline engine mounted on a skeleton frame, a collapsible arbor frame, a grinder head, and a V-type link belt. The specification provides for two types of head. Type A carries two grinding wheels which turn in the same plane as the drive belt. On the type B head (fig. H-3) the wheels turn in a plane 90° from the drive belt and the head is mounted so that the wheel position may be changed from vertical to horizontal for face grinding. This type has three spindles, so that two operators may work at the same time, or the third spindle may be used for a wire brush or buffer. The specification calls for three grinding wheels, 11½- by

10-inch No. 36-W-M, but wheels of different grit and hardness may, of course, be purchased if required.

Grinding-Wheel Dresser.

It is necessary to dress grinding wheels frequently to maintain true roundness and evenness of face. Unevenness in a wheel makes proper tool grinding impossible and causes an eccentric motion in the grinder head which results in excessive vibration and wear. Such vibration in a power grinder is dangerous:

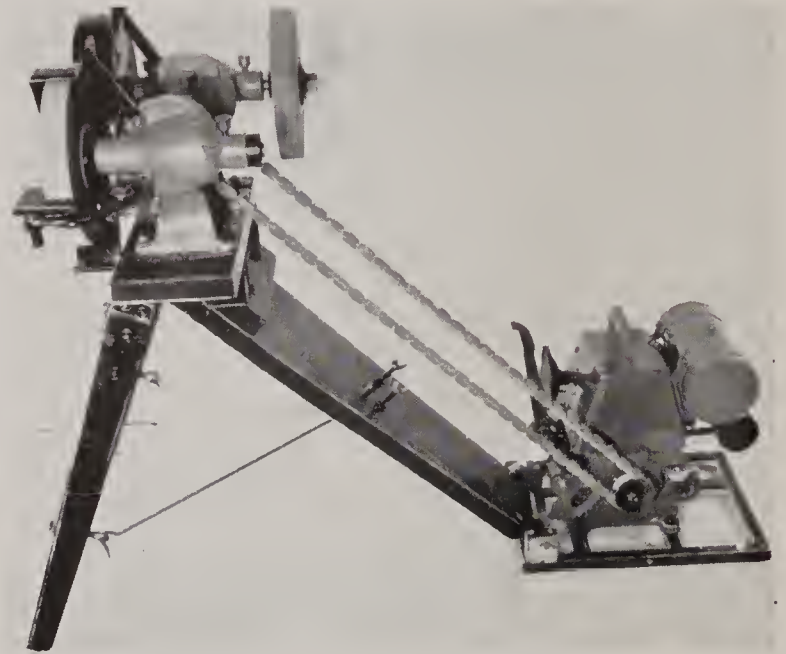


FIGURE H-3.—Portable power grinder.

heavy grinding with an eccentric wheel may result in shattering the wheel. It is often necessary to dress new wheels before using them.

One of the most common and inexpensive grinding-wheel dressers on the market is the type known as the Huntington. It consists of a japanned iron handle and holder, in which are set three tooth-faced tool-steel disks, with a guide to hold the dresser square with the face of the grinding wheel. The rotation of the toothed disk against the face of the wheel removes uneven spots and dresses the face true with the holder. Replacement disks for the dresser may be obtained at low cost.

SECTION I
HAND TOOLS AND SMALL EQUIPMENT

SECTION I

HAND TOOLS AND SMALL EQUIPMENT

Ax, Double-bit, 3½-pound, Western Pattern. (Index No. MSF-9-1.)

The western pattern ax has been adopted as the standard ax for Forest Service use in all lines of ordinary chopping work. The specification includes an outline drawing of the type of ax to be furnished and will provide a first-grade 3½-pound double-bit ax.

Ax, Double-bit, 3½-pound, Young's Pattern. (Index No. MSF-9-2.)

The Young's pattern ax (fig. I-1, 5) has been adopted as standard for Forest Service use where a falling-type ax is required. The only



FIGURE I-1.—Standard Forest Service ax patterns: 1, Belt ax; 2, boy's ax; 3, cruiser ax; 4, western pattern; 5, Young's pattern.

purpose to be served by using the Young's pattern ax over the western pattern is that the long blade permits notching trees or snags for the insertion of spring boards. The specification requires a bit approximately 11½ inches long by 4½ inches wide. The weight of the ax is about 3½ pounds. Axes meeting this specification will be first-grade tools.

Ax, Double-bit, 2½-pound, Cruiser Pattern. (Index No. MSF-9-3.)

This is the lightweight, cruiser pattern, double-bit ax designed similar to the western pattern, but weighing only about 2½ pounds (fig. I-1, 3). It is particularly adaptable for use as a saddle or car ax, or for a lightweight blazing ax. It is provided with a 27-inch double-bit handle.

Ax, Single-bit, 2¼-pound Boy's Pattern. (Index No. MSF-9-4.)

This is a lightweight, single-bit ax weighing approximately 2¼ pounds, which is designed

especially for camp use, such as wood splitting, putting up camp, etc. (fig. I-1, 2). It is provided with a 26-inch single-bit ax handle.

Ax, Belt, 1¼-pound. (Index No. MSF-9-5.)

The specification provides for a 1¼-pound, regular pattern, belt ax with 13½-inch, belt-ax pattern, curved handle (fig. I-1, 1). The bit is approximately 5½ inches long by 3⅜ inches wide at the cutting edge. The head of the ax is approximately seven-eighths inch thick by 2 inches wide.

Use of Broadax on Peat Fires.

The use of a common broadax in controlling peat-bog fires will be found quite effective. The

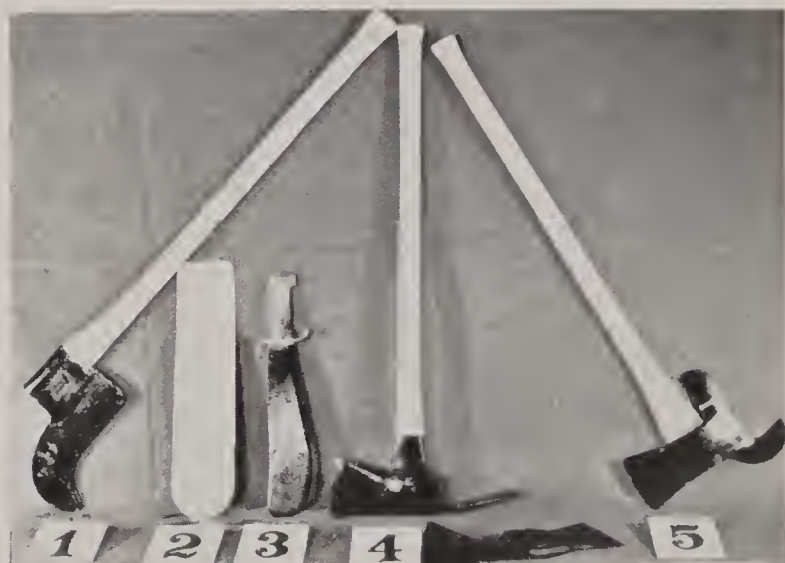


FIGURE I-2.—1, Brush hook; 2, brush-knife sheath; 3, brush knife; 4, Pulaski tool; 5, Brown tool.

broadax is used to cut a square trench to the necessary depth so that fire cannot creep beneath. The ax simply provides a longer-bladed tool of the proper shape with which to cut a perpendicular-sided trench. Since the use of a tool of this type is more or less local, a specification has not been prepared for it.

Pulaski Tool. (Index No. MSF-355.)

The Pulaski tool is a combination ax and grub hoe weighing approximately 3¾ pounds, and provided with a regular double-bit ax handle (fig. I-2, 4). The tool is manufactured in a manner similar to an ax and is constructed of first-grade tool steel throughout. It is so balanced that it can be used quite as effectively as a regular ax for chopping and the hoe part is as efficient as any type of hoe of this size. The ax bit is patterned similarly to that of a western pattern ax and the hoe portion of the tool is approximately 6 inches long by 3⅜ inches wide at the cutting edge. This particular type of tool is used extensively throughout the western Regions, and to some extent in the East.

Brown Tool (J Ax). (Index No. MSF-352.)

The Brown tool, or J ax, is a combination ax and brush hook. The ax portion of the tool is identical with the ax portion of the Pulaski tool. The brush-hook portion is shaped like the letter J and is illustrated in figure I-2, 5. The standard tool for which specification has been prepared requires a shorter tailpiece on the upper portion of the brush hook; approximately of the length indicated by the white line in the illustration. The tool is well bal-

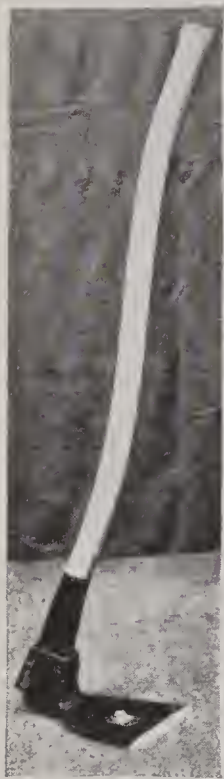


FIGURE I-3.—
Adz-eye hazel
hoe.

anced and weighs about $3\frac{1}{2}$ pounds. It is particularly adaptable to such work as trail maintenance and other jobs which require both an ax and a light brush hook. It is handled with a standard double-bit ax handle. The entire tool is constructed of first-quality tool steel throughout.

Brush Hook. (Index No. MSF-180.)

The standard Forest Service brush hook is a tool designed for heavy service (fig. I-2, 1). It is much better than an ax for slashing work and cutting small material under 4 inches in diameter. The tool is constructed of first-quality tool steel which will hold an edge in difficult cutting work. The tool is handled with a straight type of single-bit ax handle, which is held in place by two $\frac{1}{8}$ -inch

rivets after having been wedged. Should the handle become loose, it can quite easily be tightened with the rivets through the eyepiece.

Brush Knife. (Index No. MSF-218.)

The brush knife is a tool suited to light slashing work in dense brush or light undergrowth (fig. I-2, 3). It is more effective for this type of work than the ordinary hand ax because of its longer cutting edge. The knife blade is constructed of high-carbon tool steel which is provided with a horn handle and brass hand guard. It is patterned after the familiar machette brush knife. The blade is about 12 inches long by 3 inches wide at the deepest place. The weight of the tool is slightly more than the ordinary hand ax.

Adz-Eye Hazel Hoe. (Index MSF-179.)

The adz-eye hazel hoe (fig. I-3) is a digging tool constructed of first-quality tool steel throughout. It is much superior to the ordinary type of hazel hoe or other types of trench digging hoes to be found on the open market. It is provided with a standard adz eye adaptable to the standard, lightweight carpenter's

adz handle. The bit of the hoe is $8\frac{1}{2}$ inches in length. Weight without handle is approximately $2\frac{3}{4}$ pounds.

Saw Steel Hoe. (Index No. MSF-175.)

The saw steel hoe (fig. I-4) is a fixed-head hoe similar in construction to a planter's hoe. The blade is approximately $10\frac{1}{2}$ inches wide by $8\frac{1}{4}$ inches deep and is constructed of saw steel. It uses a straight hoe-type handle 50 inches in length which is fastened to the blade by a steel ferrule and $\frac{5}{16}$ -inch U-bolt.



FIGURE I-4.—Saw
steel hoe.

McLeod Tool, Solid-Head Pattern. (Index No. MSF-353.)

The McLeod tool is a heavy-duty rake and hoe combination suitable for cutting matted brush cover, heavy duff, and general rake work in clearing medium cover (fig. I-5, 1). The rake section is of the nonclogging pattern. The entire blade of the tool is pressed from saw-quality tool steel and tempered to a medium hardness. The blade is fastened to a 48-inch straight hoe-pattern ash handle with an 8-inch steel ferrule. The ferrule is riveted and welded to the steel blade and a rivet is placed through the ferrule and the ash handle. The width of both the cutting edge

and the rake side of the tool is approximately 11 inches.

McLeod Tool, Demountable-Head Pattern.

There has been no specification prepared for the demountable-head pattern McLeod tool, since the consensus from the field indicates little call for this type of tool. There is, however, a demountable-head tool on the market and also a tool very similar to the McLeod tool called the Kortick tool which may be procured by those desiring the demountable-head feature.

Tool, Combination Rake and Cutting. (Index No. MSF-284.)

The combination rake and cutting tool is what is known in some localities as the Council or Rich tool (fig. I-5, 3). It is constructed from four mowing-machine sickle cutter sections which are fastened to a piece of 1-inch angle iron to which is welded a steel planter's-hoe eye. This tool is particularly adaptable to fire-trench work in light brush and in duff containing small roots, etc. It serves as both a cutting and digging or raking tool. The

cutter sections can be replaced as they become worn or broken. The tool is equipped with a 60-inch straight planter's-hoe handle. The approximate width of the tool is 11 inches.

Asphalt-Type Fire Rake. (Index No. MSF-283.)

This is a 10-tine asphalt-type rake with a $\frac{1}{2}$ -inch square steel shank extending 10 inches in length beyond the wooden handle (fig. I-5, 2). The rake is 16 inches in width by 4 inches in depth. It is provided with a standard $5\frac{1}{2}$ -foot rake handle which is fastened to the rake with a steel ferrule and rivet.

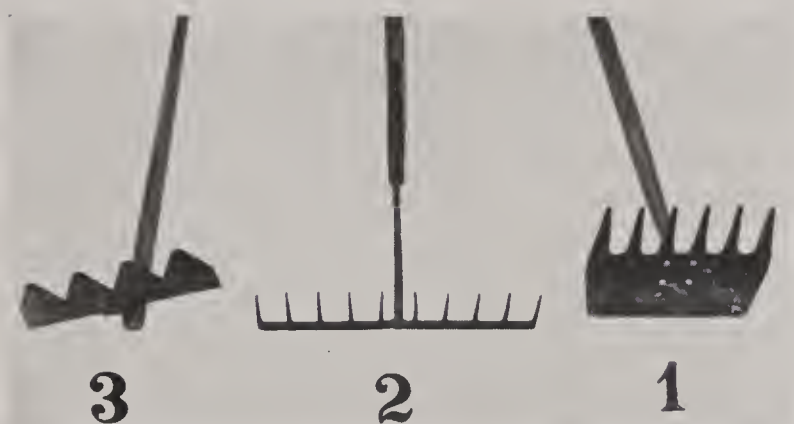


FIGURE 1-5.—Fire rakes: 1, McLeod tool, solid-head pattern; 2, asphalt-type fire rake; 3, combination rake and cutting tool.

Lawn comb-Type Fire Rake. (R9-X.)

In certain localities, especially in the hardwood regions where fallen leaves constitute the main fuel, the lawn comb-type rake has been found to be very effective in fire-control work. Several types of this pattern rake are available upon the market. Some of them are provided with fiber tines while others have spring-steel tines. Only the spring-steel tine kind are suitable for fire-control work. No specification has been prepared for this particular type of tool since the use of tools of this nature is more or less local.

Fire Swatter. (Index No. 334.)

This is a tool designed for use in suppressing fires in grass type and other similar light fuels. It is constructed of belting approximately 15 inches long by 12 inches wide which is fastened to a steel shank and handled with a hoe-pattern ash handle approximately 5 feet in length. The purpose of the fire swatter is, as the name indicates, to beat out fires.

Long-Handle Round-Point Shovel, No. 2 Size. (Index No. MSF-324-1-S.)

The No. 2 long-handle round-point shovel provided by Federal specification No. GGG-S-111 as amended has been adopted as standard for the Forest Service (fig. I-6, 1). In ordering shovels of this kind and size the following specifications should be used:

Specifications.—In accordance with Federal specification No. GGG-S-111 as amended, type E commercial size No. 2 as indicated in table I to be furnished with grade X handles except that handle lift shall be 30 inches with a tolerance of plus or minus 2 inches.

Long-Handle Round-Point Shovel, No. 0 Size. (Index No. MSF-324-2-S.)

Like the No. 2 shovel, the standard No. 0 shovel for Forest Service use is to conform to



FIGURE 1-6.—1, No. 2 long-handled, round-pointed shovel; 2, No. 0 long-handled, round-pointed shovel; 3, 8-pound sledge hammer; 4, 4-pound sledge hammer.

Federal specification No. GGG-S-111 as amended (fig. I-6, 2). In ordering shovels of this size and pattern the following specifications should be used:

Specifications.—In accordance with Federal specification No. GGG-S-111 as amended type E with grade X handle, dimensions and tolerance to be as follows:

Dimensions	Tolerance
Blade width, 8 inches-----	Plus or minus $\frac{1}{4}$ inch.
Blade length, 10 inches-----	Plus or minus $\frac{1}{2}$ inch.
Blade thickness, 0.078 inch-----	Plus 0.015 inch; minus 0.005 inch.
Handle length, 37.5 inches--	Plus or minus 1 inch.
Over-all length, 46 inches--	Plus or minus $1\frac{1}{2}$ inch.
Blade lift, 6 inches-----	Plus or minus $\frac{1}{2}$ inch.
Handle lift, 24 inches-----	Plus or minus 1 inch.
Strap length, 8 inches-----	Dimension is minimum.

Sledge Hammers. (Index No. MSF-169.)

The specification provides for either a 4- or 8-pound, double-end, Nevada or long pattern, striking hammer as specified (fig. I-6, 3 and 4). The hammers are equipped with BR grade, or better, hickory handles. The hammer is constructed of high-grade tool steel properly tempered throughout. The smaller or 4-pound size is the one ordinarily used in connection with fire-line sawing work where the timber is not too heavy. The 8-pound size is suited to heavy sawing work where large wedges are used.

Crosscut Saws. (Index No. MSF-309.)

A general specification covering all types, sizes, and patterns of crosscut saws has been prepared. The specification is intended to secure only first-quality saws regardless of size and pattern. The two types of saws recommended for general use within the Forest Service are the felling pattern and the bucking pattern (fig. I-7). The lengths of these pat-

terns can, of course, be varied to meet local conditions. It is felt that these two particular patterns with the wide range of lengths in which they are available should be adequate to meet all Forest Service requirements in a practicable manner.

The use of saws with two Diamond, Tuttle, or Champion teeth to one raker is discouraged except in very special conditions. Likewise, in most cases, there is more to be lost than gained by using saws with perforated lance cutters. The use of nonperforated lance-tooth cutters over a period of many years, and under every conceivable condition to which a tool of this nature might be subjected, indicates that they afford no trouble from the standpoint of kinking, bending, or springing, or breakage due to their unsupported length. On the other hand, they have much in their favor in the way of advantages.

They will not clog or gum up in resinous timber as easily as the perforated-tooth cutters; they clear of saw kerf more readily; and the necessity of gumming or filing out the perforations when the saw becomes worn down thereto is obviated.

Surface Gage for Crosscut Saws. (Index No. 147. Madison Laboratory-P.)

Raker Length and Set Gage for Crosscut Saws. (Index No. 148. Madison Laboratory-P.)

The Madison laboratory has designed two very convenient types of micrometer gages for use in connection with saw testing. Detailed specifications have been prepared for these two gages and are contained within the master file

under the above index numbers. The laboratory will be glad to purchase and test any gages of this kind which are desired by Forest Service units.

The surface gage is used to test the evenness and thickness gage of the saw and the raker length and set gage is used for checking teeth dimensions. The latter gage, in addition to being useful for testing new saws, is a very suitable instrument for use in connection with saw-filing work, for checking the length of raker points and the set in the cutting teeth. Both gages are provided with a clock-dial face and hand which registers one one-thousandth of an inch (figs. I-8, I-9, I-10, I-11).

In briefly describing the method of use of the gages and general procedure in testing crosscut saws, the Madison laboratory offers the following information:

Thickness of the saw can be measured with an ordinary micrometer caliper although a sight reading caliper such as is made by the Federal Products Corporation, Providence, R. I., or by B. C. Ames Co., Waltham, Mass., is more convenient for use. The latter type of micrometer is more desirable because it has a much greater reach than the ordinary type. We (the Madison laboratory) have designed a special surface gage (index No. 147) for measuring uniformity of taper and trueness of surface. The raker length and set gage (index No. 148) is also a special instrument for use in connection with testing raker lengths and cutting tooth set, which has been developed by us.

In connection with bending tests required under the standard saw specification, measurements need to be made of the body or crook in the saw both before and after bending. The difference between the two measurements indicates the amount of set produced by the bending test. A conical point added to the dial gage forming part of the raker length and set gage will make this gage suitable for use in these measurements. The conical point is suggested because its contact with the surface of the saw can be quite accurately determined by observing its reflection on the polished surface. The spring in the dial gage is sufficiently strong that if the point of the plunger is allowed to press against the saw, it will of itself produce considerable bending, hence the need for this reflection method, or something equivalent.

Twist in the saw blade can best be observed by "balancing" the saw. In doing this, the observer holds the saw near one end with a tooth near its center resting upon a support about waist high; with his hands on opposite sides of the blades and with fingers spread, he then attempts to manipulate the blade into a vertical plane. In this position, any twisting or kinks will be readily apparent (also the saw can be inspected for uniformity of taper along the back edge). If it is perfectly free from twist and kinks, the blade can be balanced in a vertical plane. We (the Madison laboratory) have not devised any method for numerical measurement of twist, consequently determination of conformity to the qualitative twist limitation in the standard specification must be left to the judgment of the inspector.

Swedish Bucksaws. (Index No. 310.)

Swedish bucksaw frames are provided in three sizes—2 feet 6 inches, 3 feet 6 inches, and 4 feet—to take blades 28 to 32 inches, 36 to 45 inches, and 39 to 48 inches in length, respectively. The saw consists of an adjustable tubular-steel frame and a thin, narrow, high-grade



FIGURE I-7.—Crosscut saws: *a*, Bucking pattern; *b*, felling pattern.

steel blade. Saws of this type are particularly adaptable where there is a considerable amount of small material to be cut. They are designed particularly for use by one man. They are extremely light in weight and cut exceptionally fast in any size material which they can handle. The teeth of the saw blade are specially designed for rapid cutting and are very simple to sharpen. Also, the saw blades are quite reasonable in cost, which permits frequent replacement.

This particular type of saw is what is known as the Bushman saw (fig. I-12) and at present is manufactured only in Sweden. It is covered by patent rights both in Sweden and in this country as well as elsewhere, so that for the present at least purchases of saws of this type may be restricted to this particular make of saw. All of the fieldmen who have used this saw proclaim it to be outstanding in performance. It is light-weight and yet sturdily constructed, making it very adaptable to use in fire outfits where transportation is a problem. The price of these



FIGURE 1-8.—Checking length of raker point with raker length and set gage.



FIGURE 1-9.—Checking set in cutting tooth.

saws ranges approximately from \$1.50 to \$2.25 each according to size. Extra blade prices range approximately from 50 to 90 cents each.

Steel Saw Wedges. (Index No. MSF-385.)

The wedge specification provides for three types of steel wedges, as follows:

1. Light-duty saw wedge available in eight different weights ranging from $\frac{1}{2}$ to 4 pounds.

2. Pacific coast falling wedge available in six different weights ranging from 5 to 10 pounds.

3. Pacific coast bucking wedge available in three weights, 6, 7, and 8 pounds.

The wedges are manufactured from a grade of steel suitable for producing first-quality tools, and they are to be tempered properly throughout.

Hardwood Falling Wedge. (Index No. MSF-386.)

A hardwood wedge shaped from clear hickory stock approximately 10 inches long by 1 inch thick at the heavy end. The wedge is sanded smooth and saturated with a spirit solution of hard wax to furnish a smooth, hard-wearing surface. This wedge is particularly adaptable to smoke chaser and flying squadron fire-crew equipment. It is similar in shape to the 6-pound Pacific coast falling wedge illustrated in figure I-13, 2.

Crosscut Saw Handles. (Index No. MSF-174.)

A clear hardwood handle equipped with slotted bolt, rivet, and wing nut for fastening to the saw. A $4\frac{3}{4}$ -inch metal hand guard is provided to cover the end of the saw. The handle may be fastened to the saw in either a perpendicular or horizontal plane as desired.



FIGURE I-10.—Illustrating method of using dial part of raker length and set gage to test evenness of saw thickness and surface.

Saw Filing Outfit. (Refer to sec. H, Grinding and sharpening equipment.)

Kerosene Can.

The 1-pint size kerosene can is a suitable piece of equipment for use on all sawing operations.

Refer to section S, Miscellaneous equipment, for further details and specification.

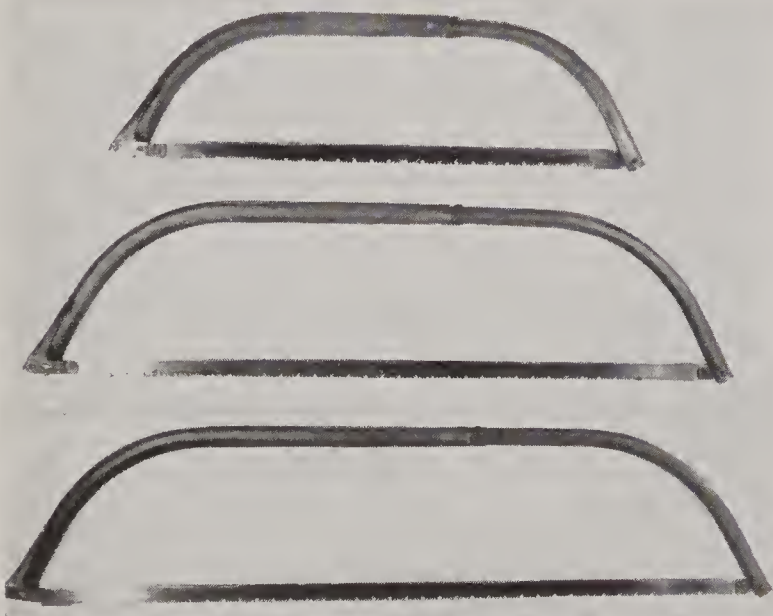


FIGURE I-12.—Swedish bucksaws (Bushman).

Saw Guard, Fire-Hose Type.

Condemned 1½-inch fire hose, preferably cotton-jacketed rubber-lined, provides a very suitable saw guard (fig. I-14, 1.) A piece of hose slightly longer than the saw to be guarded is split full length along one side and four ¾-inch harness-leather straps are riveted at equal distances along the length of the hose, to go around the saw and fasten to a buckle riveted to the opposite side of the guard. Still another means of fastening the guard over the



FIGURE I-11.—Testing thickness or gage of saw and evenness of surface.

saw teeth is to rivet a piece of web strapping about twice the length of the saw to one end of the guard and wind this spirally around



FIGURE I-13.—Timber sawing accessories: 1, 6-pound Pacific coast bucking wedge; 2, 6-pound Pacific coast falling wedge; 3, 4-pound light-duty saw wedge; 4, 2½-pound light-duty saw wedge; 5, crosscut saw handle; 6, saw-setting block; 7, raker gage; 8, cutting tooth set, spider gage; 9, swaging hammer. The last four items comprise the saw-filing outfit.)

both saw and guard, tying it at the opposite end of the saw; or, if the hose is not to be again used as a saw guard, an ordinary piece of baling wire or heavy string will suffice.

Saw Guard, Rubber Type. (Index No. MSF-161.)

The rubber saw guard is a commercially manufactured product intended for use where a thoroughly dependable type of saw guard is required (fig. I-14, 2). It is made of molded tread-stock rubber approximately 2 by $\frac{5}{8}$ inches in cross section with a slit $1\frac{1}{2}$ by $\frac{1}{8}$ inches in cross section to receive the saw teeth. A long strip of latex-covered canvas tape is fastened to one end of the saw guard for wind-

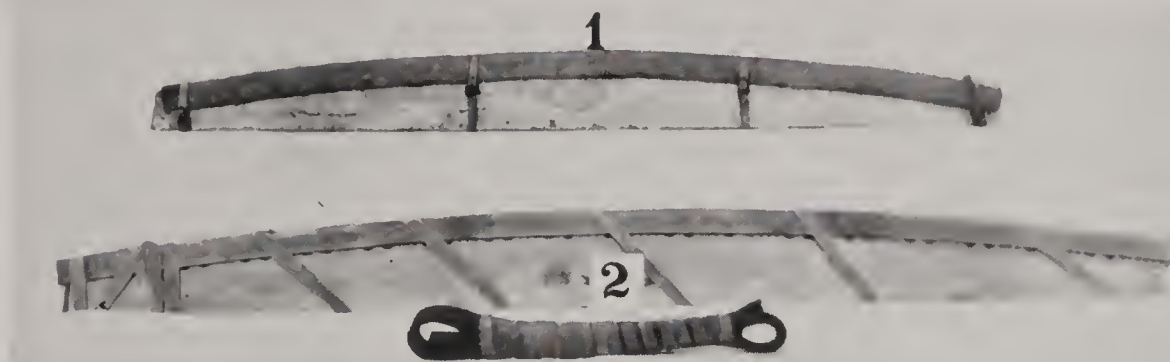


FIGURE I-14. Saw guards: 1, fire-hose saw guard; 2, rubber type saw guard.

ing around both guard and saw when the guard is in use. This particular type of saw guard is available to Forest Service units upon requisition to the Supply Depot, or it may be procured upon the specification drafted.

Peavy. (Index No. MSF-262.)

The specification provides for a lightweight peavy with a wooden stock approximately 4 feet in length suitable for use in fire-line construction work. This tool is particularly suited to mop-up work, for rolling over burning logs, stumps, and chunks, so that the fire may be put out from the under side of them.

Ax Sheath, Double-bit, Western Pattern. (Index No. MSF-314-1.)

The western pattern ax sheath (fig. I-15, 5) is constructed of first-grade harness leather, riveted throughout. It is provided with a japanned harness ring securely fastened in one end by which the ax may be carried on a saddle or elsewhere requiring a ring attachment. Filler strips of approximately one-eighth inch thickness are riveted around the edges of the sheath so that the bits cannot come in contact with the rivets or cut through the sheath.

Ax Sheath, Double-bit, Young's Pattern. (MSF-314-2.)

The same construction as the western pattern ax sheath, but designed to fit a Young's pattern ax (fig. I-15, 6).

Ax Sheath, Cruiser Pattern. (Index No. MSF-314-3.)

Constructed the same as the western pattern ax sheath, but designed to fit the cruiser pattern ax (fig. I-15, 4).

Ax Sheath, Single-bit, Boy's Pattern. (Index No. MSF-314-4.)

Constructed materially the same as the western pattern ax sheath, but designed to fit the $2\frac{1}{4}$ -pound boy's pattern single-bit ax (fig. I-15, 3).

Belt Ax Sheath. (Index No. MSF-314-5.)

The belt ax sheath is constructed materially the same as the western pattern ax sheath, but designed to fit the standard $1\frac{1}{4}$ -pound belt ax.

and provided with a belt loop for fastening to the belt (fig. I-15, 2).

Brush Knife Sheath. (Index No. MSF-321.)

This is a first-class, lightweight, harness-leather sheath designed and constructed to carry the standard brush knife (index No. MSF-218). The sheath is provided with loops so that it may be worn upon the belt. (See figure I-2, 2.)

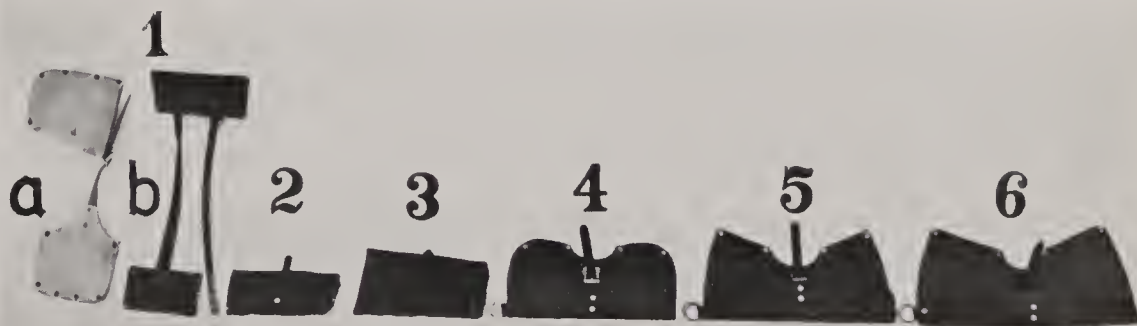


FIGURE I-15.—Sheaths: 1, a, Standard Pulaski tool sheath; 1, b, nonstandard Pulaski tool sheath, a simple design which may be home manufactured; 2, belt ax sheath; 3, boy's ax sheath; 4, cruiser ax sheath; 5, western pattern ax sheath; 6, Young's pattern ax sheath.

Pulaski Tool Sheath. (Index No. MSF-319.)

This is a sheath designed to fit the Pulaski tool, providing a leather cover for both the ax-bit and the grub-hoe parts of the tool (fig. I-15, 1). It is constructed of first-grade lightweight harness leather and is made up in two parts, the ax-bit part and the grub-hoe part being fastened together when in use with a harness-leather strap and buckle.

Electric Headlights. (Refer to sec. D, Lighting equipment.)

Handles, Double-bit Ax.¹ (Index No. MSF-172.)

A separate drawing has been made and specification prepared covering double-bit ax handles. The specification requires a handle materially the same as Federal Specification No. NN-H-91, except for dimensions. The handle provided by this specification is slightly larger than the dimension requirements indicated in the Federal specification. It is the standard size ax handle used by most ax manufacturers today. Since many of these handles are used in such tools as brush hooks, Brown tool, and Pulaski tool, where they are subjected to heavier usage than just ordinary chopping, it has been found desirable to specify the slightly larger size handle. Also, the handle provided insures a better fit in the eye of the axes, Brown tool, Pulaski tool, etc., adopted as standard by the Forest Service. BR grade has been adopted as the standard for Forest Service use.

Tool Handles, Long Type, Hickory.¹ Index No. MSF-173-1-S.)

This group of handles includes the sledgehammer handle, single-bit ax handle, adz handle, and railroad pick or mattock handle. Federal Specification No. NN-H-91, as amended, and the following classes, have been adopted as standard for Forest Service use. (See index No. MSF-172 for standard double bit ax handles.) For sledgehammer handles, single-bit ax handles, and railroad-pick or mattock handles, BR grade shall be the standard. For adz handles, for use with adz-eye hazel hoe, AR grade shall be the standard.

Tool Handles, Short Type, Hickory.¹ (Index No. MSF-173-2-S.)

Handles within this class are for use with hammers, hatchets, hand axes, and similar small tools. The specification and handle classes adopted as standard for use by the Forest Service are as follows: Federal Specification No. NN-H-96, as amended, and the grade shall be SBR.

Tool Handles, Ash.¹ (Index No. MSF-171-S.)

Handles in this class are for use with forks, hoes, rakes, shovels, and all tools of a similar nature. The specification and grades adopted as standard for the Forest Service are as follows: Federal Specification No. NN-H-81, and any amendments which may be added thereto, and the grade shall be X in all cases, except where an extremely light handle is provided in a tool intended for heavy work, in which case

it may be grade XX. Combination rake and cutting-tool handles, McLeod-tool handles, and shovel handles shall be grade X. Long fire-rake handles, fire-swatter handles, and similar long tool handles of a small diameter may be grade XX.

Fire-Tool Outfits.

There are many sizes and kinds of fire-suppression tool outfits used which are made up of many different types and combinations of tools and equipment. To list them one and all is quite impracticable as well as unnecessary. However, for the information and benefit of those who may wish to gain some knowledge of fire-tool outfits and of what they comprise, a few of the more widely used outfits are described.

Fireman or Smoke-Chaser Outfit.

The one-man fireman or smoke-chaser outfit used quite extensively throughout the northwestern Regions consists of the following items. These are, of course, modified to a certain extent, as hereinafter explained, to meet local conditions and depending upon the kind of transportation available:

- | | |
|---|---|
| 1 Canvas-lined pack board and bag. | 1 Electric headlight with extra bulb and batteries. |
| 1 Smoke-chaser map case containing 1 box pocket compass, 1 map (usually of ranger district), and pencil and report forms. | 1 File. 8-inch, flat mill bastard. |
| 1 Pulaski tool and sheath. | 1 Canteen (size according to local need). |
| 1 Shovel, No. 0 or detachable handle, long-handle, round-point. | 1 Water bag, 2-gallon. |
| | 1 Individual first-aid packet. |
| | 1 One-day emergency ration (some localities two rations). |

Some of the substitutions made to accommodate local requirements or transportation facilities are:

1. Clack pack board with light cargo canvas or a knapsack for the canvas-lined pack board.
2. Ax and hazel hoe for Pulaski tool.
3. Miners' carbide lamp with extra can of carbide or palouser with extra candles, for the electric headlight with extra bulb and batteries.
4. Ax stone for file.
5. Water bag for canteen.
6. Folding canvas bucket for water bag. The extra bag or bucket is sometimes left out entirely in localities where water is scarce as its main purpose is for carrying water to drown fire.
7. A hand pump and man pack water bag or rubber-insert water bag are sometimes included as standard items.
8. A 4½-foot crosscut saw with handle and hardwood wedge are sometimes included as standard items.

The average standard fireman's pack weighs from 20 to 30 pounds, depending upon extra items carried and whether one or two rations are included.

Crosscut Saw Carrier. (Index No. 308.)

This item is a wooden case constructed to carry 12 crosscut saws. The case, or box, is

¹ *Special notice.*—Handles of all kinds should be packaged in open-sided, wood crates. This should be a standard requirement as handles packaged in tight paper cartons will sweat and mold when stored for any length of time.



FIGURE 1-16.—One- to fifteen-man, back-pack outfit, packs 1 to 5 opened up.

made of $\frac{3}{4}$ -inch material and opens up from one end. Each saw is contained separately in a small partitioned space within the case. The length and size of the box can, of course, be varied to accommodate various lengths and patterns of saws. It can be constructed by anyone having a little carpentering ability if provided with the specification and required material. The only hardware required aside from nails and box strapping is a pair of strap hinges and hasp and staple.

One- to Fifteen-Man Back-pack Outfit.

Region 1 uses a combination 1- to 15-man back-pack tool outfit which is made up of three identical 1- to 5-man outfits (fig. I-16). It is designed especially to equip flying-squadron and other specially trained and organized crews and is particularly adaptable in localities where transportation is mainly by foot. The outfit is especially arranged for outfitting any number of men from 1 to 15 so as to insure both adequacy and balance of tools, regardless of crew size, up to that number. Three outfits make up a very effective 50-man, back-pack crew tool unit.

The outfit contains a sufficient number of lights to permit night travel and work. It also

includes a sufficient number of one-man rations to subsist the crew for about a day and a half.

Each pack is cargoes in lightweight canvas and strapped to a Clack packboard. The packs average about 19 pounds apiece including pack board.

The contents of one of the one- to five-man units included in an outfit are listed below. In some localities extra tools, such as shovels and Pulaskis, are kept with each 15-man outfit ready for last-minute substitution for the saws in packs 8 and 13 if it is felt one saw will be sufficient for the crew to be sent out.

CONTENTS OF ONE- TO FIVE-MAN OUTFIT

Pack No. 1

- | | |
|-------------------------|-----------------------|
| 1 Compass and map. | 1 Frame, pack, Clack. |
| 1 Bag, water, 2-gallon. | 1 Pack cover. |
| 6 Batteries No. 950. | 1 Ration, 1-day. |
| 1 File, 8-inch. | 1 Shovel, ladies'. |
| 1 Headlight. | 1 Tool, Pulaski. |

Pack No. 2

- | | |
|----------------------------|--------------------------|
| 1 Ax, double-bit 3½-pound. | 1 Pack cover. |
| 1 Bag, 5-gallon, man-pack. | 1 First-aid package. |
| 1 Canteen, 1-quart. | 1 Pump, hand, with hose. |
| 1 Frame, pack, Clack. | 1 Ration, 1-day. |



FIGURE I-17.—R-1, 25-man outfit packed for transporting.

Pack No. 3

- | | |
|---------------------------|-----------------------|
| 1 Frame, pack, Clack. | 2 Saw handles. |
| 1 Pack cover. | 1 Shovel, ladies'. |
| 1 Ration, 1-day. | 1 Wedge, falling, 2½- |
| 1 Saw, crosscut, 5½-foot. | pound. |

Pack No. 4

- | | |
|-------------------------|--------------------|
| 6 Batteries No. 950. | 1 Pack cover. |
| 1 Bucket, tin, 6-quart. | 2 Rations, 1-day. |
| 5 Cups, miners', tin. | 5 Spoons, dessert. |
| 1 File, 8-inch. | 1 Stone, Ax. |
| 1 Headlight. | 1 Tool, Pulaski. |
| 1 Frame, pack, Clack. | |

Pack No. 5

- | | |
|-----------------------|--------------------|
| 1 Cover, pack. | 1 Shovel, ladies'. |
| 1 Frame, pack, Clack. | 1 Tool, Pulaski. |
| 2 Rations, 1-day. | |

Twenty-Five-Man Outfit, R-1 Type.

Region 1 uses the following 25-man outfit (fig. I-17) as standard for fire-control work throughout the Region. The outfit is designed to facilitate transporting either by truck or by pack animal. Each package or box contained is so arranged that it can be made into a side pack for a pack animal just as it comes from the central warehouse or fire-tool cache, without further rearranging being necessary.

The outfit includes a sufficient number of tools, mess equipment, and bedding to completely serve a 30-man crew, including the camp and kitchen force. It is called a 25-man outfit for the reason that it is intended to equip 25 men for actual fire-line work in addition to the camp and kitchen force mentioned.

1 25-man, Nested Mess Outfit. Approximate weight 112 pounds.

Index No. MSF-247-6-S. (Refer to sec. E for contents.)

1 Auxiliary Mess-Equipment Box. Approximate weight 60 pounds.

(Refer to sec. E, Camp equipment.)

1 Torch and Miscellaneous Tool Box. Approximate weight 140 pounds.

- | | |
|-------------------------------------|---|
| 2 Bags, water, 5-gallon, man pack. | 4 Pumps, hand, with hose. |
| 2 Canteens, 2-quart. | 1 Torch, liquid gas. |
| 1 Grinder, carborundum, hand power. | 1 Board, Clack pack. |
| 12 Headlights, electric. | 1 Scale, spring, 50-pound (not required with new type torch). |
| 1 Kit, medicine, R-1 standard. | 1 Wrench, adjustable. |
| 1 Pliers. | |

1 Tool Box. Approximate weight 140 pounds.

- | | |
|--------------------------------|-----------------------------------|
| 9 Axes, 3 ½-pound, double-bit. | 1 Kit, timekeeper's or camp-boss. |
| 16 Tools, Pulaski. | |

1 Tool Package No. 1. Approximate weight 117 pounds.

- | | |
|--------------------------------|----------------------|
| 2 Axes, 3 ½-pound, double-bit. | 1 Peavy. |
| 4 Hammers, 4-pound. | 16 Shovels, ladies'. |

1 Tool Package No. 2. Approximate weight 70 pounds.

- | | |
|------------------------------------|---------------------|
| 2 Bags, water, 5-gallon, man pack. | 1 Gage, raker. |
| 4 Sacks, pack. | 1 Hammer, swedging. |

1 Crosscut saw package. Approximate weight 25 pounds.

4 Saws, crosscut 5½- or 6-foot length.

5 Bundles, *Kapok Sleeping Bags*. Approximate weight 75 pounds (each).

Each bundle contains 6 kapok bags.

1 *Stove and Fly Package*. Approximate weight 100 pounds.

- | | |
|------------------------------------|-------------------------------|
| 1 Kimmel camp stove. | 1 Oven size bake or drip pan. |
| 1 Tent fly, 14 by 16 feet. | |
| 1 Half-oven size bake or drip pan. | |

Supplemental 25-Man Outfit, R-1 Type.

Where more than 25 men are to be employed in any one crew or camp, Region 1 uses what is called a supplemental 25-man outfit (fig. I-18), which supplements their standard 25-man outfit with sufficient tools and equipment to completely outfit a 55- to 60-man crew, including camp and kitchen force, in the same manner as described under the 25-man outfit. The supplemental 25-man outfit consists of the

following packages or bundles including the items listed. Like the 25-man outfit this outfit is packed and ready for immediate transportation either by truck or by pack animal.

1 *Supplemental Mess Outfit*. Approximate weight 86 pounds.

Refer to index No. 247-7-S for list of contents.

1 *Supplemental Torch Box*. Approximate weight 136 pounds.

- | | |
|---|-------------------------------|
| 1 Torch, liquid gas. | 2 Sacks, pack. |
| 1 Wrench, adjustable. | 4 Hammers, striking, 4-pound. |
| 1 Scale, spring, 50-pound (not required with new type torch). | |

1 *Supplemental Tool Package*. Approximate weight 140 pounds.

- | | |
|------------------------------|----------------------|
| 2 Axes, double-bit 3½-pound. | 16 Tools, Pulaski. |
| | 12 Shovels, ladies'. |



FIGURE I-18. R-1 supplemental 25-man outfit packed for transporting.



FIGURE I 19. Twenty-five-man back-pack unit packed for shipment.

1 Crosscut Saw Bundle. Approximate weight 25 pounds.

4 Crosscut saws, 5½ to 6 foot length.

4 Bundles Kapok Sleeping Bags. Approximate weight 75 pounds.

Each bundle contains six sleeping bags, except one, which has seven.

Twenty-Five-Man Airplane-Delivery Outfit, R-1 Type.

Region 1 uses a standard type of 25-man, airplane-delivery fire-tool outfit. The tools are packed in nine different packages in such a manner that they can be dropped from an airplane at the point of delivery with little or no damage resulting. For further details regarding the method of packaging employed, refer to part 3 of the handbook. The standard aerial-delivery outfit is made up of the following tools:

Package No. 1

3 Axes, double-bit 3½-pound w/hose sheaths.	6 Files, 10-inch, wrapped individually.
2 Pumps, hand, with accessories.	2 Files, 7-inch, crosscut saw, wrapped individually.

Package No. 2

6 Pulaskis.

Package No. 3

6 Pulaskis.

Package No. 4

7 Shovels.

Package No. 5

7 Shovels.

Package No. 6

2 Saws, 5½-foot, crosscut.

Package No. 7

5 Handles, crosscut saw.	2 Hammers, 4-pound.
4 Wedges, 2½-pound.	

Package No. 8

1 Kit, first-aid.	2 Bags, water, 5-gallon, man-pack.
2 Bags, water, 2½-gallon, with hose connection.	

Package No. 9

16 Candles, stonebridge.	2 Headlights, electric.
4 Lanterns, stonebridge.	12 Batteries, flashlight.

Twenty-Five-Man Outfit, R-4 Type.

Region 4 uses a 25-man outfit quite similar to that used by Region 1 except that the packaging arrangement is somewhat different. The entire outfit is put up in two separate units. Unit 1 (fig. I-19), or the first to go to the fire, is called a 25-man back-pack outfit and unit 2 (fig. I-20), or the second half of the outfit, is called an additional or follow-up outfit. The purpose of this arrangement is to place in the first unit the tools which will be needed by the men immediately upon arrival at the fire. The second unit includes camp equipment and the balance of the tools not taken to the fire by the crew. You will note that in this outfit Region 4 includes 25 emergency rations in the back-pack unit. This is intended to take care of the crew until such time as the rest of the outfit can be transported to the fire and camp established.

UNIT 1

25-Man outfit, back-pack

10 Baby shovels.	2 Kettles.
2 Axes, double-bit, 3½-pound.	4 First-aid kits, small.
12 Pulaski tools.	25 Knapsacks or pack frames.
1 Saw, crosscut, 5½- or 6½-foot, falling type.	1 Hand pump with back-pack can or bag.
6 Files, 10-inch, flat mill bastard.	1 Pint kerosene for saws.
2 Whetstones, round.	1 Timekeeper's kit and forms.
1 Hammer, 2½-pound (or 4-pound).	1 Pair saw handles, crosscut.
2 Wedges, falling, 1½ pound.	1 Can for oiling saws (filled).
15 Electric light head lamps and extra batteries.	12 Fuses for burning out.
5 Water bags, 2½-gallon.	25 Hand towels and 5 cakes soap.
2 Water bags, 5-gallon man pack.	1 Marker, 4-yard.
	25 Emergency rations.



FIGURE 1-20.—Twenty-five-man follow-up unit packed for shipment.

UNIT 2

Additional or follow-up equipment needed for extra period or project fires, each 25 men already on the fire.

- | | |
|--|---|
| 5 Baby shovels. | 1 First-aid kit, large. |
| 5 Axes, double-bit, 3½-pound. | 1 Kimmel stove, with 2 drip pans for oven. |
| 2 Saws, crosscut, 5½- or 6½-foot. | 2 Hand pumps with back-pack bags or cans. |
| 1 Saw-filing outfit, with swedging hammer. | 2 Lanterns, gas, with 10 mantles, 2 generators, pair pliers and small funnel. |
| 6 Files, 10-inch. | 1 Quart kerosene. |
| 1 Tool grinder. | 5 Gallons gasoline. |
| 2 Hammers, 2½-pound (or 4-pound). | 2 Pair crosscut-saw handles. |
| 4 Wedges, falling, 1½-pound. | 2 Cans for oiling saws. |
| 5 Water bags, 2½-gallon. | 1 Commissary box with padlock and keys. |
| 5 Waterbuckets, canvas. | 25 Fuses. |
| 1 Outfit, 25-man, nested mess. | 5 Washbasins. |
| 1 Canvas fly, 10 by 12 feet. | 6 Grady wedges. |

Supplemental 25-Man Outfit, R-4 Type.

Like Region 1, Region 4 maintains a standard supplemental 25-man outfit which is used to supplement their regular 25-man tool outfit to equip a 50- to 60-man crew (fig. I-21). The following items are those which are included within the R-4 supplemental 25-man outfit:

- | | |
|-------------------------------|-----------------|
| 10 Shovels, baby. | 25 Plates, tin. |
| 6 Axes, double-bit, 3½-pound. | 25 Cups, tin. |
| 10 Pulaski tools. | 25 Forks. |
| 25 Beds, kapok. | 25 Knives. |
| | 25 Spoons. |

Ten-Man Outfit.

The following list of contents of a standard and a back-pack, 10-man outfit (fig. I-22) is offered as information to handbook readers. This particular outfit is used in certain localities throughout the northwestern Regions. With certain modifications it should prove adaptable to a good many localities.

	Standard set-up	Back-pack set-up
Baby shovels.....	6	5
Axes, double-bit, 3½-pound.....	3	2
Pulaski tools.....	7	5
Saw, crosscut, 5½- or 6½-foot falling pattern.....	1	
Files, 10-inch, flat mill bastard.....	6	4
Ax stone, round.....	1	1
Hammer, 2½-pound (or 4-pound).....	1	
Wedges, ¾-pound falling.....	2	
Lanterns, Stonebridge, and 24 candles or electric headlights.....	4	5
Water bags, 2½-gallon, or canteens.....	5	5
Water bag, 5-gallon man pack.....	1	
Waterbuckets, canvas.....	3	1
Cook outfit, nested, with 4 dish towels and 5 hand towels.....	1	
First-aid kit.....	1	
Knapsack or pack frame.....	2	
Bags, cotton, lunch.....	12	
Hand pump with pack cans or bags.....	1	
Kerosene for saw (quart).....	1	
Fuses for burning out (dozen).....	1½	
Timekeeper's kit and forms.....	1	
Saw handles, crosscut (pair).....	1	
Can for oiling saws, flat type (pint).....	1½	
Gas lanterns (12 mantles, 1 generator, pliers, extra).....	2	
Gasoline for lanterns (gallon).....	2	
Kapok beds to be centrally stored and sent with men, or food supplies.....	12	10
Lunch bags, cellophane.....	30	
Wedges, ax, Grady (dozen).....	1½	
First-aid kits, small.....		*2
Time slips.....		*12
Cook outfits, 1-man, 2 dish towels, 5 hand towels, and 5 soaps, guest size.....		*5
Rations, emergency, 1-day. How many needed will depend on how soon pack horses can bring in provisions.....		*20
Kettles, nested, or 1 kettle and 1 coffee pot.....		*2

* Items marked with an asterisk (*) are extra equipment, and will be omitted unless clearly needed.

Back-pack set-up will be eargoed or boxed and marked in such manner as to be quickly segregated from standard outfit.

Twenty-Five-Man Outfit, R-6 Type.

Region 6 uses the following 25-man outfit (fig. I-23) as standard for shipment from central warehouses for fire-suppression work:



FIGURE 1-21.—R-4, 50-man outfit comprised of a 25-man outfit, units 1 and 2, and the 25-man supplemental outfit.

Mess equipment No. 1

- 1 25-man mess outfit, Index 247-6-S.

Stores No. 2 (unless Otherwise Specified)

- 1 Kimmel stove and 1 Set campfire irons.
pipes.

1 Box "Tools, Miscellaneous" No. 3

- | | |
|--|-----------------------------------|
| 6 Bags, water, 2-gallon. | 6 Handles, saw, cross-cut. |
| 3 Water buckets, canvas. | 1 Kit, first-aid. |
| 2 Canteens, ½- or 1-gallon. | 2 Rasps, wood. |
| 1 Case, carrying for timekeeping forms. | 3 Headlights, electric. |
| 12 Files, 10-inch. | 1 Torch. |
| 6 Files, 8-inch. | 2 Pumps, spray. |
| 1 Outfit, saw-filing. | 2 Cans, back-pack. |
| 1 Padlock, ordinary. | 4 Lanterns, with oil. |
| 4 Knapsacks. | 1 Grinder, carborundum, with oil. |
| 1 Outfit, cobbler's. | 1 Lantern, Coleman, mantles. |
| 8 Stones, ax, carborundum. | 12 Hazel hoes, handled. |
| 3 Sledges, 8- or 4-pound. | 2 Saws, falling. |
| 1 Box "tools, fallers" (for westside forests): | 1 Saw, crosscut. |
| 2 Pair irons, springboard. | |
| 12 Bolts, ⅜-inch, and nuts. | |
| 1 Combination wrench and brace. | |
| 6 Wedges, saw, 5- or 6-pound, or | |
| 6 Wedges, saw, 2½-pounds (for eastside forests). | |
| 12 Axes, double-bit handled. | |
| 12 Shovels, long handled, round-pointed. | |

Tentage

- 1 Fly for 10 by 12 tent (14 by 16).
1 Tent, 10 by 12.

Beds (unless Otherwise Specified)

- 25 Bed rolls, made up of 4 single wool blankets and 1 canvas cover, or
25 Kapok beds.

Fifty-Man Outfit, R-6 Type.

In addition to the standard 25-man outfit which is maintained at central warehouses for dispatching to fire, Region 6 also maintains a standard 50-man outfit (fig. I-24). The standard 50-man outfit consists of the following tools and equipment:

Mess Equipment No. 1

- 2 Boilers, 50-man, or
2 25-man mess outfits, and
2 25-man mess boxes.

One Box "Tools Miscellaneous" No. 2

- 6 Water buckets, canvas.
4 Canteens, ½- or 1-gallon.
24 Files, 10-inch.
12 Files, 8-inch.
2 Rasps, wood, 12- or 14-inch.
12 Bags, water, 2-gallon.
1 Padlock, ordinary.
16 Stones, ax, carborundum.
1 Kit, first-aid.
6 Headlights with batteries.
2 Outfits, saw-filing.

Stores No. 3 (Unless Otherwise Specified)

- 2 Kimmel stoves with 1 Set campfire irons.
pipe.

One Box Saw Tools No. 4 (West Side)

- | | |
|--|--|
| 12 Wedges, saw, 5- or 6-pound, or | 2 Lanterns, Coleman with mantles. |
| 12 Wedges, 2½-pound (east side) and | 1 Outfit, cobblers. |
| 4 Pairs springboard irons. | 24 Hoes, hazel, handled. |
| 24 Bolts, ⅜ by 3 inches with nut. | 24 Axes, double-bit, hung. |
| 2 Combination wrench and brace with ⅜-inch bits. | 8 Sledges, 8- or 4-pound. |
| 2 Torches. | 24 Shovels, long-handle, round-point. |
| 4 Cans, back-pack. | 2 Saws, crosscut, — feet (according to requisition). |
| 4 Pumps, spray. | 4 Saws, falling, — feet (according to requisition). |
| 8 Lanterns and oil. | 1 Timekeeper's outfit, roll or box, 50-man. |
| 2 Grinders. | 8 Sacks, pack. |
| 12 Handles, saw. | |

Tentage

- 2 Tents, 10 by 12 feet. 2 Flies, 14 by 16 feet.



FIGURE 1-22.— Ten-man outfit ready to go.



FIGURE I-23.—R-6, 25-man outfit ready for transporting.



FIGURE I-24.—R-6, 50 man outfit.



FIGURE I-25.—R 2, 10-man tool cache.

Beds (Unless Otherwise Specified)

50 Bed rolls, made up of 4 single, wool blankets and 1 canvas cover, or 50 Bags, kapok.

Ten-Man Outfit R-2 Type.

Region 2 and other regions having similar fire conditions use the following 10-man outfit for small crew and ranch fire-tool cache pur-

poses (fig. I-25). The outfit illustrated is cached in one of the standard-type metal fire-cache boxes, index No. 61-2. The outfit consists of the following tools:

- | | |
|-------------------------|------------------------------|
| 8 Long-handled shovels. | 2 1-gallon canteens (2 |
| 3 Double-bit axes. | 2½-gallon water bags |
| 2 Pulaski tools (2 mat- | permissible). |
| tocks permitted as | 1 5-gallon water bag. |
| substitutes). | 1 Canvas waterbucket. |
| 1 one-man saw (1 two- | 1 Oil lantern. |
| man saw permissi- | 1 Gallon of coal oil in can. |
| ble). | 1 Time book with pencil. |
| 2 10-inch files. | Burlap or gunny sacks |
| 3 1-quart canteens. | for packing. |
| 1 First-aid packet. | |

Five-Man Tool Cache, R-2 Type.

The following five-man tool outfit is used by Region 2 and other localities having similar fire conditions. This outfit is particularly adaptable for use in connection with ranch tool caches and tool caches located in out-of-the-way locations where a small number of tools is likely to be needed for fire-suppression work:

- | | |
|----------------------------|---------------------------|
| 4 Long-handled shovels. | 2 1-gallon canteens. |
| 1 Double-bitt ax. | 1 Canvas waterbucket. |
| 1 Saw (either one- or | 1 Oil lantern. |
| two-man). | 1 Gallon coal oil in can. |
| 1 File, 12-inch. | 1 First-aid packet. |
| 1 Mattock or Pulaski tool. | 1 Time book and pencil. |
| 2 1-quart canteens. | Burlap or gunny sack. |
| 2 2½-gallon water bags or | |

Two 5-gallon, back-pack pump outfits complete are considered standard equipment at rangers' headquarters and all forest headquarters' caches.

Twenty-Four-Man Tool Cache, Eastern Region Type.

Figure I-26 illustrates one type of tool cache used in certain localities within the eastern Regions. There is no list provided herewith, since most of the items are clearly discernible in the illustration. The cache box illustrated is the box described under index No. 61-6.

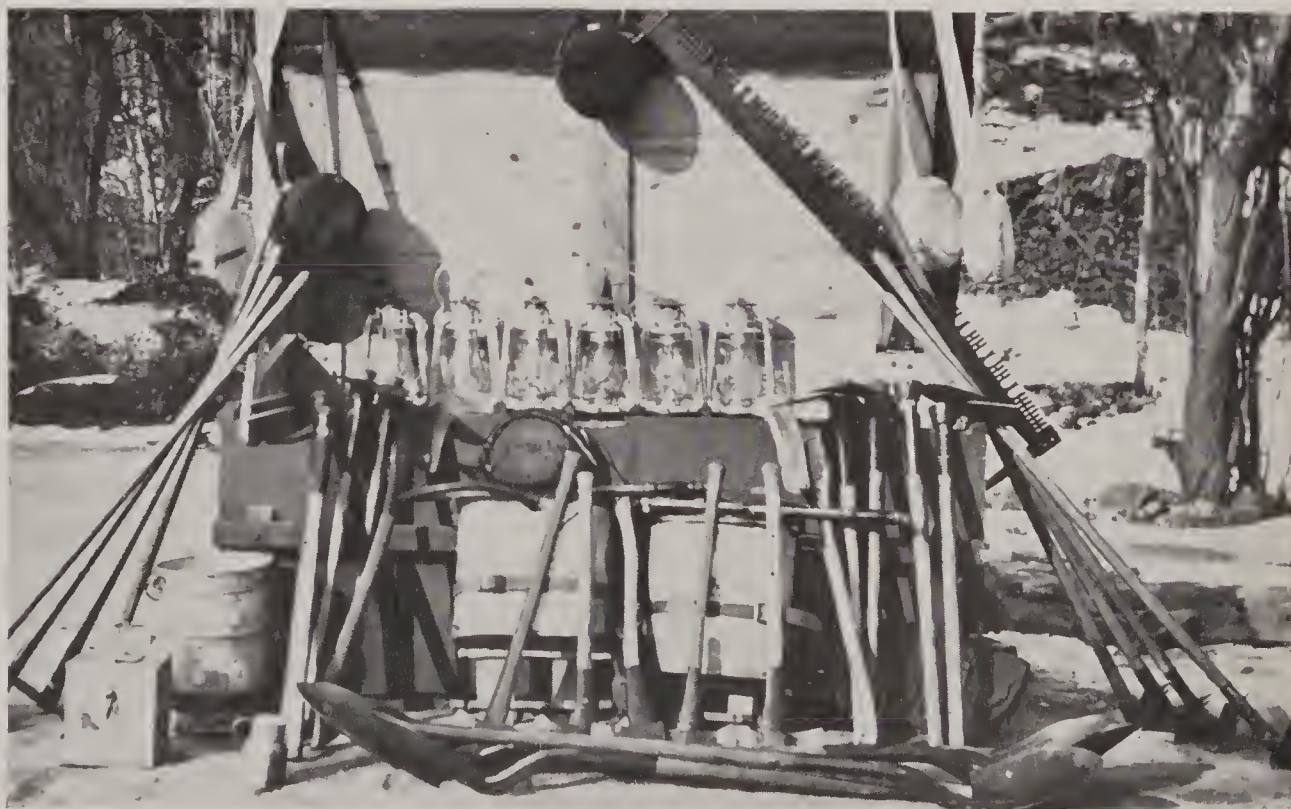


FIGURE I-26. —Twenty-four-man tool cache, eastern Region type.

SECTION J
BACK PACKING EQUIPMENT

SECTION J

BACK PACKING EQUIPMENT

Clack Pack Board. (Index No. MSF-55.)

A lightweight, skeleton pack board or frame of sufficient strength to stand heavy use in packing fire equipment (fig. J-1). Designed and constructed so that load may be hung high



FIGURE J-1.—Clack pack board.

or low according to individual requirements. Usually the load is wrapped in light canvas. (See index No. 85-S.) Board is made of clear, straight-grained hickory, joined with copper rivets; carrying and lash straps of webbing. Length of board, 22 inches; width, 10 inches, except bottom cross member which is 16 inches. Forest Service units may obtain these boards from Region 1, where they are manufactured at a cost of approximately 75 cents each.

Canvas for Back Pack Cargoing. (Index No. 85-S.)

Suitable material for cargoing articles to be carried on pack boards may be purchased under Federal specification No. CCC-D-761, B-1, type 1, either class A, gray, or class B, dyed and finished. The width and weight should be specified. Eight-ounce duck is suit-

able, but a lighter or heavier product may be used. The width should be not less than 36 inches.

Knapsack (Packsack). (Index No. MSF-214.)

Made of No. 10 duck, colored olive drab and waterproofed, or natural-finished gray duck as may be required (fig. J-2). Size $6\frac{1}{2}$ by 14 by 17 inches high, with flap $16\frac{1}{2}$ inches long



FIGURE J-2.—Knapsack.

and 16 inches wide. Has inside pocket 8 by 12 inches and inside tie straps at top. Shoulder straps are of $2\frac{1}{4}$ -inch webbing and both shoulder straps and flap straps are secured at outer ends with buckles. The specification provides that a 2-inch reinforced slit in the center of the bottom may be required, with an inside flap for covering the slit when it is not in use. This is to permit use of the standard knapsack with the rubber-insert water bag (index No. MSF-33), thus obviating the necessity for a special knapsack for this purpose.

Canvas Lined Pack Board. (Index No. 56.)

A collapsible pack board designed for heavy packing where the clack pack board is not suitable. The frame consists of four pieces of light wood—two side members and upper and lower cross members. The side members are beveled and grooved at both ends to permit lateral expansion of one-half inch when the cross members are fitted and drawn toward each other by means of a threaded rod. The canvas lining is also divided and laced through grommets at the back to provide for further lateral adjustment. Carrying straps are of suitable webbing. Six hooks are provided for

lashing on the pack or for attaching a pack-board bag (index No. 56-1). Over-all dimensions 26 by 14 inches. Length of canvas lining 25 inches. Weight approximately 3 to 4 pounds.

Figure J-3 shows the unassembled parts of the pack board, including the canvas lining; ends of lining not shown.



FIGURE J-3.—Canvas-lined pack board.

Pack-Board Bag. (Index No. 56-1.)

Designed for use with canvas-lined pack board (index No. 56) when necessary to pack a number of small articles (fig. J-4). Made of 10-ounce olive-drab duck. Length 20 inches, width 13 inches, depth at top 9 inches, depth at bottom 6 inches, inside dimensions. Has 15-inch inside pocket, and flap 18½ by 16½ inches. Grommets are provided on each side to fit over lash hooks on pack board.



FIGURE J-4.—Pack-board bag.

SECTION K
TORCHES AND BACKFIRING EQUIPMENT

SECTION K

TORCHES AND BACKFIRING EQUIPMENT

Torch, Liquid Gas. (Index No. MSF-359.)

The liquid gas or liquefying petroleum gas torch is designed for use in backfiring and mop-up work in connection with fire control and is also an ideal piece of equipment for brush burning (fig. K-1). It consists of a cylindrical steel container I. C. C. standard tested tank approximately $7\frac{1}{4}$ inches in diameter by $25\frac{1}{2}$ inches in height, dimensions including the control valve at the top. The burner equipment which accompanies the container to make up the torch consists of a 48-inch length of acetylene hose with a control valve conveniently located in the center for use by the operator. The burner consists of a piece of heavy brass tubing approximately five-eighths of an inch in diameter by 2 feet in length to which is attached a copper-bronze burner head approximately 2 inches in diameter by 6 inches in length. The approximate weight of the entire torch assembly without gas is 32 pounds. The capacity of each individual tank varies to some extent but the usual average is about 10 pounds of liquid petroleum gas which makes a gross load of from 40 to 42 pounds including the back-pack board. The particular type of pack board best adapted to use with the torch is the Clack pack board (index No. MSF-55). The torch is fastened to the board by two pieces of lightweight thin steel strap and bolts equipped with wing nuts.

Each torch tank is equipped with a safety plug which is so constructed that it will blow out at a given pressure, thus eliminating any danger from the tank itself blowing up when overloaded or overheated. The top-valve assembly on the tank is protected by three upright pieces of iron rod welded in place around the valve and to which a round iron ring is welded at the top as illustrated. The new style torch provided by the designated specification differs from the old style torch which has been used until recently in that it is no longer necessary to weigh the container and determine the amount of gas used to refill the container by weight. The weighing method has been eliminated by the inclusion in the valve assembly of a small needle valve which is called a 10-percent valve. This 10-percent valve has a small, brass tube which projects downward from the top of the container directly into the tank for 10 percent of the interior length of the tank itself. When refilling this small valve is opened up and the refilling operation allowed to progress until liquid begins to come therefrom. This then denotes that the tank is

filled to capacity with a reserve air space of 10 percent and the filling valve may then be closed.

In order to obtain best results from this particular type of torch, liquified petroleum gas which meets the requirements set forth in specification No. MSF-150-S should be used. With this type of gas and the type of burner used it is unnecessary to preheat the burner to ignite it, and it will not overheat or blow up.



FIGURE K-1.—Liquefied petroleum gas torch with extra nipple for refilling through regular burner hose.

The following sets forth the instructions which should be followed when refilling torches of this type:

- (1) Supply cylinder must be above torch cylinder before commencing to refill.
- (2) Connect pig-tail or burner hose from supply cylinder to torch tank, open valves on each cylinder.
- (3) Then open the small 10-percent valve on top cylinder just enough to allow vapor to escape.
- (4) Allow liquid to flow into torch cylinder as soon as vapor appears from the small 10-percent valve. When liquid appears, cease filling by closing the two main valves on both tanks and the 10-percent valve.
- (5) When filling, always stand torch cylinder straight up—never lay on its side.

CATION.—After closing of valves on both cylinders, including the 10-percent valve, be careful to disconnect the pig-tail or burner hose on account of gas remaining therein. Do not fill small cylinder near any flame or fire. Do not allow any matches to be ignited nearby.

Each tank or cylinder contains a standard I. C. C. inspection plate on which appears the gross weight of the container, the capacity, and instructions for general use.

Liquid Gas. (Index No. MSF-150-S.)

Liquified petroleum gas suitable for use in torches (index No. MSF-359) must provide adequate vaporization at low temperatures, have a high heating value and a reasonably low vapor pressure, and be of such composition that its combustion and flame characteristics will not be altered as the cylinder becomes depleted. It must also be free from corrosive compounds, free sulphur or water, and should contain an odorant so that leaks in the container or connections will be quickly detected. There are various commercial gases available



FIGURE K 2.—Flame thrower ready for use.

which possess all of the required characteristics for satisfactory operation of the liquid-gas torches.

The following specification will secure a suitable gas for the purpose and has been adopted as standard for the Forest Service:

SPECIFICATION

The composition of the gas in volume percentage shall be as follows:

Ethane	-----maximum--	2.5
Propane	-----minimum--	95.5
Iso-butane	-----maximum--	2.0

Vapor pressure shall not exceed 150 pounds per square inch at a temperature of 75° F. or 300 pounds per square inch at 130°.

Heating value shall be approximately 2,550 British thermal units per cubic foot.

The gas shall be free from corrosive compounds, free sulphur, or water, and shall contain an efficient kind of odorant such as is usually associated with artificial gas, in an amount not exceeding 0.05 percent of the fuel, to facilitate detection of leaks.

When released at 60° F., the expansion of the liquid shall be approximately as follows:

Cubic feet of gas per pound	
of liquid-----	8.5
Cubic feet of gas per gallon	
of liquid-----	36.0

Flame Thrower. (Index No. MSF-138.)

The flame thrower is an attachment for the standard Forest Service back-pack pump (fig. K-2). The nozzle is removed from the pump and the flame thrower is attached by means of the nozzle thread. The flame thrower is furnished with 1/4-inch pipe thread to fit the standard hand-pump nozzle adapter. The internal design is such that a high turbulence is produced on the pressure stroke of pump causing a highly aerated stream to be ejected across a lighted wicking. The aerated stream carries the flame to the objective and ignites such oil as reaches the ground unburned. The check valve in the nozzle body cuts off the oil at approximately 5 pounds pressure.

Saw oil, Diesel oil, or kerosene should be used. **Never use gasoline or similar explosive fuels.** Make certain that the tank cap is tight, also the pump packing and attachments. The only hazard existing in the use of this device is accidental spilling of oil on the clothing of the operator. No person with oil on his clothing should use a flame thrower or approach an open fire.

The proper position for the ignition taper or wick is approximately 1 1/2 inches beyond the nozzle. Saturate the wick and light it. Thereafter, hold the wick below the nozzle so that a few drops of oil will reach it on each stroke of the pump. If there is a strong wind blowing, it might be necessary to hold the wick against the wind so that the flame will cross the nozzle of the flame thrower.

The flame thrower is designed to produce a large volume of fire and heat for burning out islands left along a control line, defoliating standing fuel, igniting green, piled brush and other fuel on rights-of-way, and backfiring under adverse conditions. The quantity of fuel used is directly proportional to the amount of firing required for a particular job.

The flame thrower is not a substitute for the liquid-gas or similar type blast torches. It is intended for an entirely different class of work. No preheating is necessary and no burner or mixing chamber is required. It operates cold at all times and it is this distinctive feature which makes of it a safe firing device.

Blast type torches are unsuited to defoliating green fuels and similar jobs which can readily be accomplished with a flame thrower

due to its oil-saturating principle together with a much greater flame projection and heat volume range.

Fusee Backfiring Torches. (Index No. MSF-360.)

Fusee backfiring torches prove a very effective tool for setting backfires and burning out control lines under certain conditions and within certain limitations. They are exceptionally well adapted to use with back-pack outfits and other similar lightweight, fire-tool outfits used by smoke chasers, flying squadrons, etc., where transportation is a problem. Fusees are easily stored and can be kept from year to year without loss or deterioration.

The specification provides for two sizes of fusees, as may be required, the 10-minute size and 20-minute size. These fusees burn at their maximum heat for minimum periods of 10 and 20 minutes respectively. They are equipped with a tin ferrule which may be used either as a handle or into which may be inserted a slender branch, sapling, or other stick to serve as a longer handle. They are self-igniting and will burn under any sort of weather conditions. In fact, they will not go out when submerged in water. They contain such materials and are so constructed that they are entirely safe in every respect in storage, handling, or transporting.

The fusees are required to be constructed within a maximum diameter of $1\frac{1}{2}$ inches and a maximum over-all length of 25 inches. The 10-minute size would, of course, be much smaller than these maximum dimensions. They come packed twenty-four 10-minute size to the box and twelve 20-minute size to the box.

Each torch or fusee has instructions for igniting and handling printed upon the side thereof.

Fire-Starting Bomb. (Index No. 60.)

This item is an efficient type of fire-starting bomb for use in connection with burning out of control lines or backfiring where the fuels are such that it is difficult to reach them with a torch or other type of fire-starting implement. They are particularly useful in heavy brush types which are more or less impenetrable by a man unless some cutting is done. In such cover or fuel type, the fire-starting bomb can be ignited and thrown into the area or fuel body to be burned (fig. K-3).

The bombs are available in various sizes according to need and are constructed of a sort of Pyrolin or zylonitelike substance which is shaped in the form of a cylinder and contains a certain amount of cotton waste thoroughly saturated with fuel oil. The most desirable size of bomb to use is one which approximates from $1\frac{1}{2}$ to 2 inches in diameter and from 8 to 12 inches in height. This size, when fully loaded with waste and fuel oil, weighs less than a pound, so that a considerable number of bombs can be transported by one man in a knapsack or on a pack board.

Each bomb is oilproof throughout the bottom and sides and the top is tightly corked



FIGURE K-3.—Fire-starting bombs of various sizes.

with an ordinary type of cork. To use the bomb the cork is simply pulled out of the top, the cotton waste ignited and the bomb thrown to the location where the fire is to be set. The bombs are entirely safe to handle as well as to store or transport even when filled with fuel oil. The proper way to prepare the bomb for use is to purchase the outer shells filled only with the waste and cork and then fill them with fuel oil as required.

A bomb of the size described is capable of producing an extremely hot flame from 2 to 4 feet in height and will burn for about 15 or 20 minutes without material let-up. The shell or bomb case is, of course, inflammable and burns up so that the entire amount of waste and fuel oil is exposed to ignition and flame shortly after throwing the lighted bomb.

SECTION L
HAND PUMP EQUIPMENT

SECTION L

HAND PUMP EQUIPMENT

Back-pack Water Can. (Index No. MSF-79.)

The standard back-pack water can is constructed of galvanized iron, the front and back being 26 gage and the side plates and bottoms being 24 gage (fig. L-1). The bottom of the

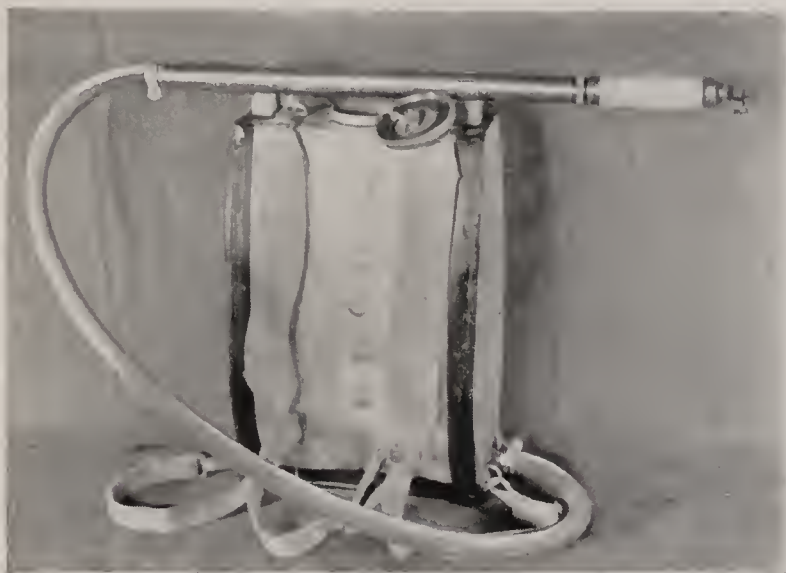


FIGURE L-1.—Back-pack water can, complete with hand pump and wire-insert hose.

can is reinforced throughout for durability. The capacity is approximately 5 gallons. Extra heavy web shoulder straps are used, and also a chest strap of the same material is provided. An automatic check valve is provided in both the can outlet and top cap. These valves are both watertight and oiltight. The top check valve opens automatically when the lower or outlet valve is opened. The outlet valve is automatically opened when the hose nipple is screwed into the outlet flange. These features permit the can to be loaded and transported in any convenient manner without the need of additional plugs, etc., to prevent leakage.

The hose nipple provided with the can is designed to be used with either $\frac{3}{8}$ - or $\frac{1}{2}$ -inch hose, whichever may be desired. Bronze spring clips are provided on the top of the can in order that the standard hand pump may be carried therein. If a handle is desired by which to carry the back-pack can, a piece of suitable leather or web strap with ordinary harness snaps on each end makes a very good handle which may be readily snapped into the shoulder strap D rings fastened to the top of the can itself. The can is thoroughly waterproof and oilproof throughout and therefore is adaptable to use with either the hand pump or the flame thrower.

The can is constructed to the form-fitting design which has been worked out after considerable study and tests with various designs of back-packing equipment. While at first glance it appears to be rather awkward and

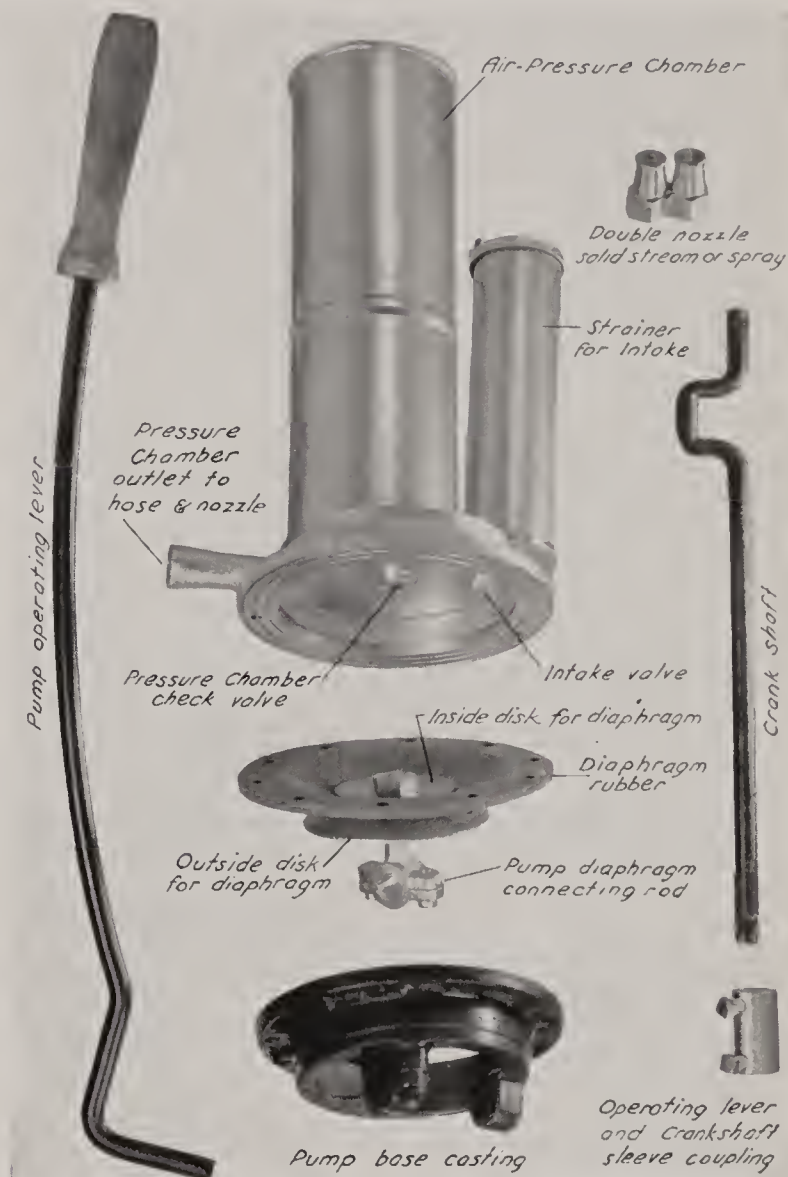


FIGURE L-2.—Working parts, pressure chamber, and inlet strainer of the air-pressure type back-pack outfit.

would not seem to be comfortable upon a man's back, most users of the can have found it to be entirely satisfactory.

Back-Pack Outfit. Air-Pressure Type. (R9-X.)

A comparatively recent, but apparently meritorious development in connection with back-pack pump outfits, is a new air-pressure type of unit. The outfit consists of a back-pack can in which is installed an air-pressure chamber and diaphragm-type pressure pump (fig. L-2). The pump is worked by a hand lever which is conveniently located near the right hand of

the operator about breast high. The objectionable feature of other types of pressure outfits is done away with by employing a separate pressure chamber. There is little or no danger of the outfit being blown up by compressed air. The net water capacity of the present outfit is slightly less than the standard back water can, being only about 4 gallons. The weight of the entire outfit when filled with water and ready for operation is approximately 50 pounds. The cost of the present outfit is about \$10 complete.

Some of the advantages of this type outfit over the old style, hand-pump outfit are: (1) It

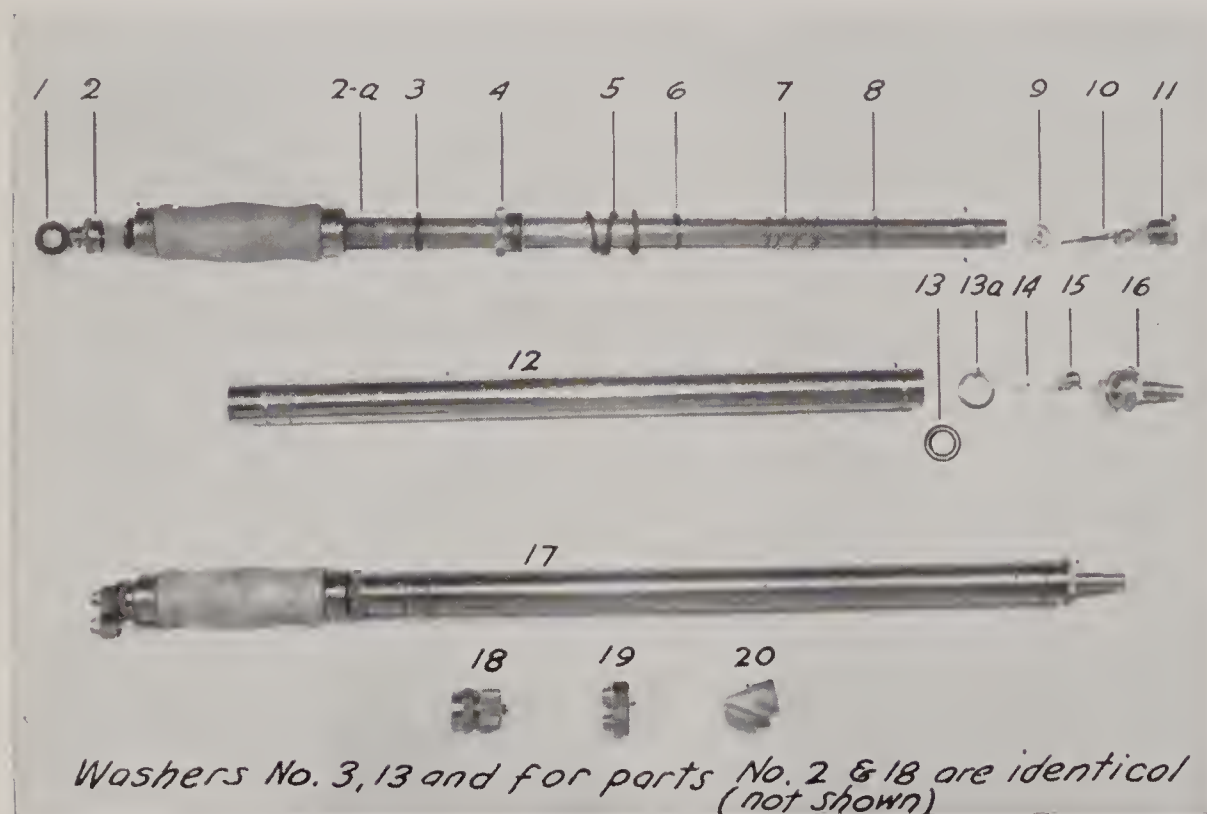


FIGURE L-3.—Back-pack hand pump showing component parts and three types of nozzles.

is easier to operate. (2) It saves water by closer utilization due to the fact that the hand directing the stream spray has nothing to do but press a small release valve. Also, there is no loss due to siphoning through the pump when the release valve is closed, and there is positively no leakage. (3) The size of stream or spray ejected can be regulated by the amount of pressure applied through the pump.

While the outfit in its present state has some undesirable features, all of these are such that they can very easily be overcome through modification or construction designing, after which it is believed this type of outfit will warrant consideration right along with the old style hand-pump outfit.

Outfits such as the one described are manufactured by the H. B. Hudson Manufacturing Co. and P. B. Smith Co. For further detailed information with regard to the outfit, or regarding further developments, refer to the regional forester, Milwaukee, Wis.

Hand Pump, Back-Pack Type. (Index No. MSF-277.)

The standard back-pack hand pump is what is commonly called "the single-action, trombone-type pump." It is a positive displacement pump with the piston acting alternately for suction and discharge. The pump is practically identical with the more or less familiar Armstrong, Indian, and Forester pumps. The pump is of about 8 cubic inches capacity and is made of brass throughout, with wooden hand grip. It is so constructed that it may be used with either water or oils without excessive leakage. A variety of three types of nozzles is provided for use with the pump. It is equipped at the rear end with a special combination hose nipple adaptable for use with either $\frac{3}{8}$ - or $\frac{1}{2}$ -inch hose.

The single-action pump was selected as standard after a series of tests in which all makes and models of pumps were compared for stream projection, ease of operation, accuracy of stream direction, and general serviceability. It was found that where conservation of water was of prime importance that the single-action type of pump provided for in the specification is the most desirable type for use in fire-control work.

The following list of parts to the pump, which is cross referenced to figure L-3, can be used to order spare parts for the standard hand pump:

- 1 Washer, leather, nozzle, for parts 19 and 20.
- 2 Adapter, nozzle, for parts 19 and 20.
- 2a Plunger tube complete with handle.
- 3 Washer, plunger cushion, leather.
- 4 Packing gland nut.
- 5 Packing, plunger.
- 6 Washer, packing seat.
- 7 Spring, plunger.
- 8 Washer, plunger spring retaining.
- 9 Washer, guide for plunger check-valve stem for part 10.
- 10 Valve, check, plunger, complete.
- 11 Seat, plunger check valve.
- 12 Cylinder, pump.
- 13 Washer seat, brass, for part 13a.
- 13a Washer, leather, seal for part 16.
- 14 Retainer, cylinder check valve for part 15.
- 15 Ball, cylinder check valve.
- 16 Adapter nut and valve body for $\frac{1}{2}$ - and $\frac{3}{8}$ -inch hose.
- 17 Pump complete with No. 19 nozzle.
- 18 Nozzle, combination, three sprays, one straight stream.
- 19 Nozzle, two-piece, straight-stream and fan-spray.
- 20 Nozzle, adjustable, straight-stream and fan-spray.

Back-Pack Hand-Pump Nozzle, Fan-Spray Type. (Index No. MSF-277-1.)

This nozzle is made of brass and is threaded to $\frac{1}{4}$ -inch pipe thread to fit the threads upon the outer end of the hand-pump nozzle adapter. This nozzle has a $\frac{3}{32}$ -inch smooth-bore hole for straight-stream projection; a revolving cutaway disk is provided which can be turned across the direction of the stream, creating a fan spray. (Refer to figure L-3, 20.)

Back-Pack Hand-Pump Nozzle, Three-Spray Type. (Index No. MSF-277-2.)

This is a brass nozzle provided with a revolving turret top and is usable with the back-pack hand pump and does not require the use of the nozzle adapter. It is threaded with $\frac{3}{4}$ -inch 24-thread to engage directly with the threads upon the outer end of the pump barrel. In addition to the regular solid stream, the nozzle provides three different spray streams—coarse, medium, and fine. (Refer to fig. L-3, 18.)

Back-Pack Hand-Pump Nozzle, Twin-Nozzle Type. (Index No. MSF-277-3.)

This particular nozzle consists of a solid-stream nozzle and a spray-stream nozzle welded together. Each separate nozzle is threaded to fit the standard hand-pump adapter. Unless otherwise specified, this is the type of nozzle ordinarily furnished with the pump. (Refer to fig. L-3, 19.)

Three-Eighths-Inch Rubber Hose (for hand pump). (Index No. MSF-186-1.)

This is a $\frac{3}{8}$ -inch hose constructed of oil- and water-resistant rubber composition, wrapped with five plies of closely woven, high-tensile strength fabric, and covered on the outside with the same grade of rubber material. The exterior diameter of the hose is $1\frac{1}{16}$ of an inch. This particular type of hose is especially adaptable to use with back-pack outfits where

extremely light weight and compactness are desired. The hose may be looped into a coil 6 inches in diameter without danger of causing collapse.

One-Half-Inch Rubber Hose (for hand pump). (Index No. MSF-186-2.)

This hose is constructed of oil- and water-resistant rubber stock, with a woven braid of hawser-twist, high-tensile strength cotton insert. The outside diameter of the finished hose is approximately seven-eighths of an inch. This type of hose is intended for use where a slightly heavier hose is needed than the $\frac{3}{8}$ -inch size, but where the requirements are such that the standard wire-insert hose is not suited.

One-Half-Inch Wire-Insert Hose (for hand pump). (Index No. MSF-186-3.)

This type of hose is recommended for use with the back-pack pump outfits wherever practicable. It is exceptionally pliable and weighs very little more than the $\frac{1}{2}$ -inch rubber hose. Its weight is 4 ounces per linear foot. The outside diameter of the finished hose is approximately fifteen-sixteenths of an inch. The hose is constructed of oil- and water-resistant rubber stock, having a 21-gage spring-steel music-wire insert, which is covered by a circular-woven fabric jacket. Both the interior and the exterior of the hose are thoroughly rubber covered. This particular hose is especially suited to withstand exceptionally severe usage. It is impossible to kink this hose under any ordinary service conditions.

Gravity Hose Intake.

No specification has been prepared for this particular item, since it is felt that where such equipment is needed, a suitable intake for a gravity hose may be devised by using an ordinary suction hose strainer, several sections of suction hose, and an ordinary gate valve with an adapter to couple the intake hose into the main discharge line.

SECTION M
POWER PUMP EQUIPMENT

SECTION M

POWER PUMP EQUIPMENT

Portable Power Pumps. (Index No. MSF-273.)

Portable power pumps may be classified according to type. At present there are available commercially four distinct types: the lightweight, air-cooled pumper; the heavier type, air-cooled pumper, which has a provision for removing the engine in order to reduce weight for packing by manpower; the lightweight, water-cooled type; and one other water-cooled type of slightly greater weight equipped with a centrifugal type pump. The three units first mentioned use a standard type of rotary pump.

Light weight and compactness are essentials of portability and for comparable performances, the air-cooled units are much heavier than the water-cooled pumps. The latter type usually employs a high-speed two-cycle engine, the performance of which has been very unreliable until developments of the past few years removed practically all of the starting and carburetion difficulties.

The centrifugal-type pumper available is of large capacity but low pressure; a combination which is not suited to field conditions which require long lengths of hose and a moderate nozzle pressure.

The rotary pump is far from an ideal type for field work where water must be pumped from streams which invariably have a considerable amount of fine grit in suspension in the water. Excessive wear results and the efficiency of the pump is soon reduced to a point where overhaul becomes necessary. The ideal pressure range for field work is 250 to 300 pounds. Capacity at that pressure should be approximately 15 gallons per minute. Such performance presents mechanical difficulties for a rotary pump since it is impracticable to design a pump of this type which will give such performance for a reasonable period without introducing a factor of high construction cost.

Early type two-cycle pumps proved very unreliable in service and it was this characteristic which eventually brought about the development of pumps using four-cycle air-cooled engines. The latter, however, are rather heavy to be classed as portable when considered from the standpoint of manpower transportation. Several models permit removal of the engine or other heavy component to reduce weight for portability, but considerable bulk still remains to be handled. Rotary valve development and its introduction into two-

cycle motor construction together with improved ignition systems, have relieved the situation for two-cycle engines until now it is possible to secure the same reliable performance from them as has been expected heretofore of four-cycle units. The air-cooled engines now regularly furnished with portable power pumps are considerably underpowered when viewed from the angle that the pump is capable of delivering a given amount of water at a stated maximum pressure. It is generally recognized that with a positive-displacement rotary pump the delivery is in direct ratio to the revolutions of the pump. If the pump could be turned to a higher speed than now is possible with the air-cooled units, the pressure and capacity would show a decided increase; all of which would mean a greater range of usefulness in field service.

A survey of field needs indicates that there is a demand for pumper performance somewhat in excess of that now generally obtainable with existing models. The following requirements cover in general the features which should be incorporated in any portable power pumper designed for forest fire-suppression work. The essential mechanical design necessary to meet all requirements indicated is entirely practicable within the present state of development in pumper construction.

Weight and dimensions.—Extreme compactness and a minimum of weight are necessary to insure portability. The weight of a one-piece unit should not exceed 75 pounds; a two-piece unit should weigh less than 100 pounds, with the heavier of the two pieces weighing not to exceed 60 pounds. The height of an assembled unit should be within 20 inches and the complete unit should be confined within a basal area of 3 square feet.

Material.—Corrosion-resistant material of first quality should be used in the construction of the various parts of the unit to the extent necessary to insure against any and all mechanical failures due to this cause throughout the normal life of the unit.

Alinement.—The unit should be so constructed and assembled as to assure proper alinement of all working parts throughout a normal life.

Draft, pressure, and volume.—A pumper should have a suction draft of not less than 11 inches of vacuum when new and 7 inches after 100 hours of operation. When new, it should also be capable of delivering 60 gallons of water per minute at 100 pounds pressure

and 20 gallons per minute at 225 pounds. These are essential performance standards if pumpers are to fulfil service requirements to the extent possible and practicable.

Power plant.—Pumps which will meet the water volume and pressure requirements specified necessarily require a certain minimum of power for efficient operation. In order to insure adequate power for all occasions encountered in actual service, engines should develop not less than 7 brake horsepower at normal operating speeds.

The ignition system of any unit should be self-contained and, to avert starting difficulties encountered heretofore, separate coils and breaker points should be provided for each cylinder if the normal operating speed of the unit requires more than 3,000 make-and-break contacts per minute. The entire electrical system should be adequately protected against dust, oil, and moisture.

Any unit, in order to be of sufficient dependability for fire-suppression work, should start under any normal operating conditions with not to exceed three spins with the starter rope.

The cooling systems of water-cooled units should be provided with efficient sediment traps, means for returning cooling water to main pump, and all pipes, valves, and fittings should be of not less than $\frac{3}{8}$ -inch inside diameter to preclude clogging too easily.

The development of power pumpers, especially those of the extremely portable type, has been handicapped because of the rather restricted market for such equipment. Like many other items of forest fire-suppression equipment, the need for pumpers of this type is limited to the requirements of a comparatively small number of users. In addition thereto, the average annual operating time of pumpers is extremely low. Due to these facts, there has been a decided lack of incentive for manufacturers to push development of equipment of this type; thus the gap between the performance characteristics of many of the pumpers now on the market and service needs. This does not represent too great a handicap, however. The recent uptrend in the use of power pumpers has incited developments which make it entirely practicable and well within present-day manufacturing standards to produce the type of pumpers that will fulfill service requirements. Developments in engines and in centrifugal-type pumps point toward the probabilities of a high-powered, compact, lightweight unit of this type not too far in the future.

The standard specification for portable power pumpers embodies such requirements as are deemed necessary to secure equipment of a type which will most effectively fulfill service requirements and yet come well within the realms of practicability of present-day manufacturing.

Power-pump accessories.—Refer to section N, Power-pump accessories, for all types of fire hose, suction hose, tool kits, and power-pump accessories of any nature.

Power Pumps, Low-Pressure, Semiportable. (R9-X.)

A few Forest Service and other protective agencies have made very effective use of the Fairbanks-Morse typhoon or similar type pumps as a part of their regular fire-suppression water equipment along with such rotary pumps as the portable power pumpers.

The most commonly used pump is the Fairbanks-Morse self-oiling typhoon type, pressure 100 pounds, speed 270 revolutions per minute, capacity 1,000 gallons per hour. The main advantages of this pump over the higher-pressure, higher-speed equipment is that it is simple in operation, has long life, and is durable and substantial. Another point of particular value is that the cooling system is entirely separate from the flow of water and no damage can be done to the equipment due to a failure in the water supply. This point is very important when the pump is being used to draw water from a driven-well point when the supply of water may be limited or suddenly terminated. Likewise, it is possible to pump dirty water without damaging the pump materially, whereas with gear-type pumps that is impossible.

When the supply of water is clean and unlimited, and durability and upkeep are not factors, the portable power-pumper type of equipment is satisfactory. The latter type is also superior when transportation is difficult and the topography is rough, due to the fact that it requires four men to carry the Fairbanks pump or pumps of similar design.

When this pump is mounted on skids, two bars can be extended through the frame extending out on each side for about 24 inches to enable four men—two on each side—to transport the pump in tandem fashion. By employing this method the pump can be carried up to one-half mile from the truck without difficulty.

This particular type of pump is useful where transportation is not a problem and where a large volume of water is desired at low pressures. It is also particularly adaptable in pumping from shallow-driven or jetted wells or elsewhere where the water contains grit and dirt.

Power Take-off Pumps, Fan-belt Driven.

During the past few years various designs of pumps have been placed on the market which are intended to be driven by a V-belt and an auxiliary pulley which is driven by the fan belt of the motor. A sufficient number of such units have been placed in operation during the past 3 years to get an idea of the practicability of this type of drive.

(1) The capacity and pressure range of the pumps offered is such that it requires several horsepower to drive them to maximum performance. While a pressure regulator is installed in the pump body to prevent overloading, experience indicates that field personnel will alter the adjustment of this regulator to get maximum performance out of the unit with the result that the fan belt will burn out after only a short period of use. It has been necessary to carry several extra belts with such pumps. If the performance is in the pump, the field will try to get the maximum.

(2) The fan and generator of the motor itself are a load of several horsepower at normal operating speeds. Adding to this the load of

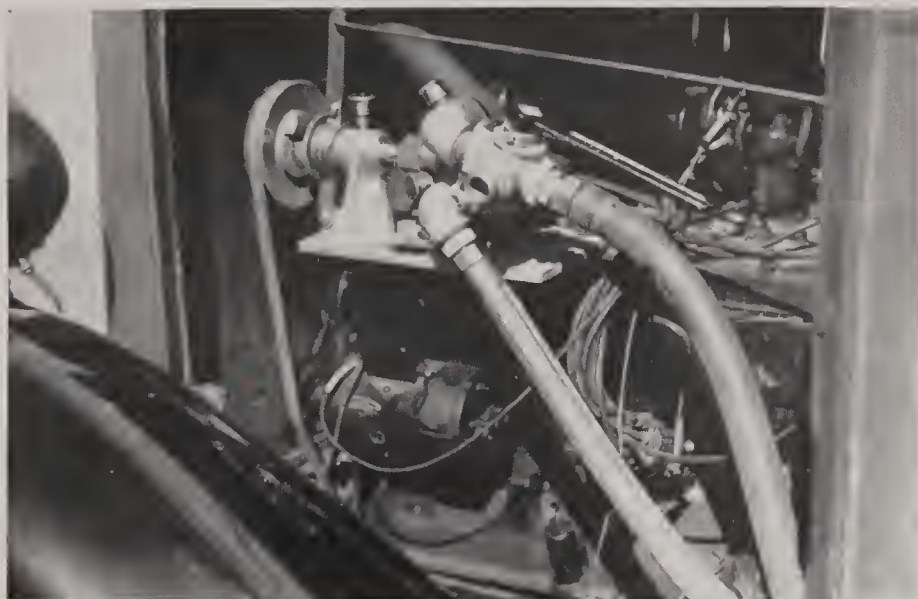


FIGURE M-1. Fan-belt driven type of pump, installed.

the pump is an unsatisfactory method of applying power. The fan belt will not satisfactorily handle the power load required under such conditions.

(3) The various changes in design under the hood of automobiles with each new model make it difficult to adapt such a drive to all makes of trucks and pick-ups. The positioning of the pulleys and speed ratios which must be introduced present a new problem with each year's model. A minimum traction surface of approximately 40° is required for a satisfactory drive with V-belts.

It is suggested that where pumps of any type are required, that they be mounted on a bracket or frame member under the cab and a suitable ratio drive be installed which will operate from a power take-off which can be installed on any truck-type transmission (fig. M-1). The drive can be stepped up from the direct ratio power take-off through a V-belt of large enough power capacity that the motor will operate the pump to capacity at slow motor speeds. There is no object in speeding the 40-80-horsepower motor of an automobile or truck to do a job which does not require more than 5 or 10 horsepower. If it is desirable to in-

stall such pumps in the manner suggested on pick-ups with a 1½-ton rating, it will be necessary to require a truck-type transmission since this is the only type which provides an opening for a power take-off.

Tractor Mounted Pump. (Michigan Forest Fire Experiment Station, Roscommon, Mich.—X.)

This is a combination of machines worked out at the Michigan Forest Fire Experiment Station, Michigan Department of Conservation, Roscommon, Mich. The undertaking was carried out cooperatively by the Cleveland Tractor Co., the Novo Engine Co., and the staff of the Michigan Forest Fire Experiment Station. This combination could be worked out with other types of tractors.

The perfection of the machine consisted of adapting the Novo pump to Cletrac tractors of the 20-horsepower class. The experiment station believes that the adaptation should be made preferably to the Cletrac tractors known as 20-C Fire Fighter, the Hillside Special, Cletrac E-38, and Cletrac AG. All of these tractors employ the same type of transmission housing and will accommodate without any change whatever the special bracket which has been perfected for mounting the pump in correct position with reference to the power take-off of the tractor.

A special bracket is necessary which can be furnished by either of the cooperating companies. This bracket bolts onto the transmission housing of the tractor and necessitates raising the tractor seat a small amount. The bracket itself is further braced by means of attachment to standard bolt holes in the rear of the tractor at that point where the drawbar emerges from beneath the transmission case.

The power take-off was furnished by the Cleveland Tractor Co. as specified on its Sheet No. 17719. The power take-off sheave and the pump sheave were supplied by the Novo Engine Co. Attention is called to bulletin No. 170 issued by the Novo Engine Co.

Since the first model of this unit was completed, improvements have been made in the intake line and the discharge manifolds of the pump itself, specifications of which may be secured from the Michigan Forest Fire Experiment Station. The remodeling of the intake and discharge lines results in a saving in weight of approximately 75 pounds.

Brief specifications of the unit are as follows:

Tractor.—Cleveland machines as mentioned above, preferably model AG, 20-C, or E-38.

Power take-off.—As specified on Cleveland Tractor Co. blueprint sheet 17719.

Pump.—Model DW-200, manufactured by the Novo Engine Co., Lansing, Mich.

Type.—Duplex double-acting.

Bore and stroke.—4 by 4 inches.

Intake.—2 inches.

Discharge.—1½ inches.

Capacity range.—60 to 100 gallons per minute.

Pressure range.—Up to 200 pounds.

Back-gearing within the pump.—5-to-1 ratio.

Accessories.—Relief valve, coil-mounted pressure gage, 2 pressure domes.

Drive.—V-belt type, 4- or 6-groove sheaves. Driven, pitch diameter, 12.4 inches; drive, pitch diameter, 9.4 inches; belts, four or six No. 1 section, No. 1824 or No. 2700.

Weight of pump.—460 pounds without bracket mounting and before converting manifolds.



FIGURE M-2.—The tractor-mounted pump.

Operating speed and performance.—The performance of the pump depends on the speed at which the tractor motor is driven. The maximum governed speed is 1,200 revolutions per minute; the corresponding speed on the power take-off is 800 revolutions per minute, and the corresponding pump speed is 300 revolutions per minute, or 70 piston strokes per minute; displacement, 60 gallons per minute. Under unusual conditions, motor speeds of 1,400 revolutions per minute are possible, with capacities ranging from 60 to 100 gallons per minute. The speed combinations have been worked out to give a yield of 60 gallons per minute at normal operating speeds, which corresponds to the average capacity of wells when correctly established. Furthermore, it balances nicely with the total capacity of one main line of 1½-inch hose when operating at high pressure.

Results secured.—This combination of machines is very flexible. The tractor can be used in standard kinds of duty with no interference whatever from the pump. When all plowing work has been done, the unit can be immediately assigned to mop-up work as a pumping unit. If hose is carried on a trailer, the machine can transport and lay its own hose line and return to the pumping site for further duty. Inasmuch as the tractor makes the pump exceedingly mobile, it can be taken into difficult situations or into swampy areas where the transportation of other types of heavy-duty

units would be difficult. The machine has been backed to the edges of streams without any construction of roads whatever and performed excellently as a pumping unit. It has gathered up hose by means of a trailer after work has been done under exceedingly adverse conditions.



FIGURE M-3.—Tractor-mounted pump and truck-mounted tank, winch, and derrick.

It is adaptable to pumping from wells or from free supplies. Furthermore, it is suitable for trailing booster outfits or water tanks on trailers along fire fronts and drafting water



FIGURE M-4.—Trailer-mounted tank, winch, and derrick.

from a tank to be discharged through the pump onto the fire. A simple hook-up of an intake hose makes this possible (fig. M-2).

The unit must be considered as a high-capacity machine capable of heavy duty for long periods. The high capacity must be discharged through two main lines inasmuch as one main line of ordinary hose cannot transport the delivered capacity which is developed, if pump is operated to its maximum capacity.

The unit is admirably adapted for transporting trailer-mounted well-sinking outfits into difficult situations and to provide the pumping power for sinking the wells, as well as drafting water from them. Due to the fact that the difficult work of transporting equipment is taken care of by the tractor with suitable trailers, a much smaller crew can be used than when other types of pumping equipment are employed.

Shallow-Well Sinking Equipment. (Michigan Forest Fire Experiment Station, Roscommon, Mich.—X and R9-X.)

The Michigan Department of Conservation offers the following information regarding the jetting method of sinking shallow wells for



FIGURE M-5.—Trailer-mounted piston-type pump with four-cylinder engine.

forest fire-suppression work and the type of equipment (figs. M-3, M-4) required to do the job. All illustrations courtesy of Michigan Department of Conservation.

Since 1932, the Michigan Department of Conservation has employed the use of shallow wells in fighting forest fire. A definite system and technique of well sinking has been perfected, and the equipment necessary to perform the work has been designed and completed. A number of units are in the field and are being rigidly standardized at the present time.

Many areas throughout the United States have high-water tables where supplies of water can be reached within 22 feet of the ground surface. Such areas permit the use of shallow wells and shallow-well pumping equipment where free water supplies are scarce or entirely lacking. Even in areas where surface water is comparatively abundant but where long hose lines are necessary, the task of pumping can be made much easier and the work greatly facili-

tated by the use of shallow wells. The wells are so easy to establish that the Michigan Department of Conservation no longer willingly considers the operation of hose lines longer than 1,500 feet in areas where wells can be established. It is preferable to establish wells rather than to operate hose lines in excess of 1,500 feet from free supplies. The use of wells is not intended to replace the practice of pumping from free supplies; it is simply intended to augment existing water supplies or to develop pumping chances where free supplies do not exist.

The equipment required to establish shallow wells is relatively simple, and the technique is within the capacity of any well-organized fire-fighting organization. The equipment consists of any power pump capable of discharging at least 40 gallons per minute, and a pressure range up to 200 pounds is desirable, although most of the work can be done with pumping equipment capable of pressure ranges as high as 125 or 150 pounds. High-pressure ranges are desirable, however, when obstinate strata



FIGURE M-6.—Trailer-mounted piston-type pump with conventional stationary type single-cylinder engine.

of soil are encountered beneath the surface of the ground.

Two makes of duplex double-acting piston pumps have proved very successful in well pumping (fig. M-5, M-6). These units are the Fairbanks Morse typhoon pump rated at 2,500 gallons per hour, known as outfit No. 6775; and another reliable machine, the pumping unit known as outfit No. DW-200, manufactured by the Novo Engine Co. of Lansing, Mich. Both of these units consist of duplex double-acting piston pumps powered by gasoline motors of adequate power. They are decidedly heavy-duty units which must be mounted on trailers for purposes of transportation, and under those circumstances where they can be towed to a pumping site by means of a truck or a tractor, their use is recommended in preference to portable machines.

In certain instances, however, trailer-mounted units cannot be used and it is absolutely essential to employ a portable unit capa-

ble of operating wells. One machine suitable for this purpose is portable fire pump PF-1 manufactured by the American Steam Pump Co., Battle Creek, Mich. The unit consists of a centrifugal pump driven by a four-cycle motor of automotive type. As a matter of fact, its capacity is greater than either of the piston outfits mentioned and it is just as reliable in operation. It could be employed with equal satisfaction at any pumping site where the heavy-duty machines are normally used.

Rotary pumps are absolutely unsuited for well pumping and can be ruined within a few minutes. It is unavoidable that a certain quantity of sand must pass through the pump until the well has been operated for a short time, and



FIGURE M-7.—Washing nozzle inserted inside well casing and casing wrench being used to turn casing.

even though these quantities of sand are relatively small, they will completely ruin the rotors of a rotary pump within a very short time.

The pump selected for well sinking work, is equipped with its complement of intake and discharge hose. The rest of the well sinking equipment consists of a supply tank capable of transporting 250 gallons of water, a set of well casings consisting of $3\frac{1}{2}$ -inch boiler tubing, a washing nozzle consisting of $\frac{3}{4}$ -inch pipe equipped with a set of nozzle tips with orifices of various sizes ranging from one-fourth to one-half inch and fitted with a return bend and a female union or hose coupling on the upper end. The length of the washing nozzle must equal or slightly exceed that of the longest casing in use, of the required length must be secured by joints and couplings. A nozzle stop is necessary in conjunction with the washing nozzle and the casing. A specialized wrench, known as a casing wrench, is necessary (fig. M-7). This wrench is the only means by

which the casing can be controlled while it is being inserted into the ground. The usual range of small tools, such as pipe wrenches, end wrenches, etc., should be included in the tool equipment, together with a variety of pipe fittings to be used as repair parts.

The well equipment itself consists of a high grade of well point or well screen, the best of which are manufactured by the Edward Johnson Co. Inc., St. Paul, Minn., and Clayton Mark Co., Chicago, Ill., and the A. D. Cook Co., Lawrenceburg, Ind. Those sizes of screens and well points which are fitted for attachment with 2-inch pipe are recommended. Complete literature and engineering assistance is readily supplied by any of these companies in the selection of correct well equipment.

The well pipe itself consists of standard 2-inch pipe and may be cut into lengths convenient for transportation. The total length of a well pipe and screen preferably exceeds the length of the casing used at any particular pumping site by about 1 foot.

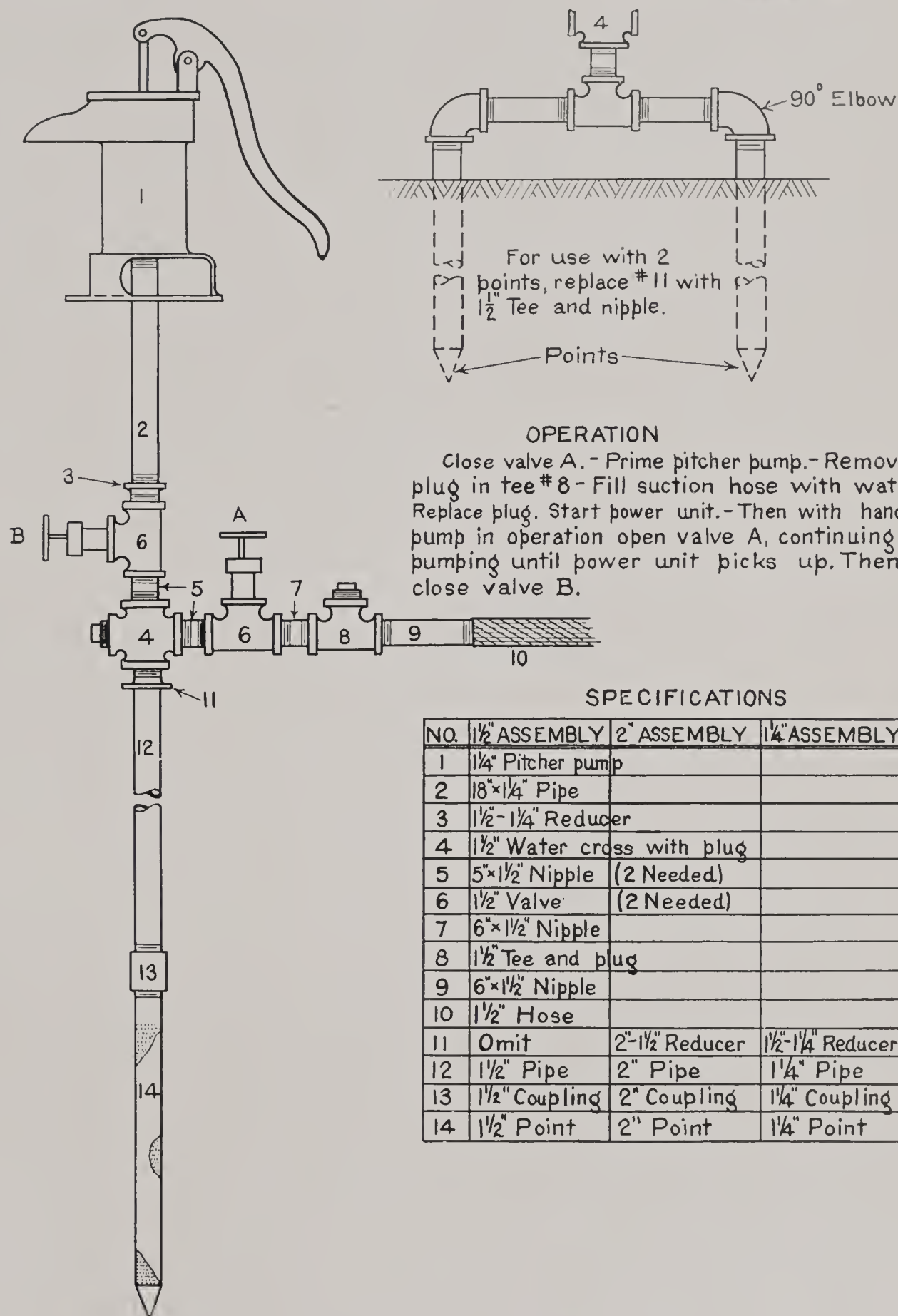
As far as equipment is concerned, care must be exercised in the selection of pipe fittings, intake hose, and the couplings with which they are fitted. It is absolutely necessary that the outlet valves on the tank, the intake hose of the pump, and the well pipe agree absolutely in size and thread. Two-inch pipe fittings are recommended throughout for the tank, the intake line of the pump and the well pipe, and the absolute standardization on iron-pipe thread is also recommended. The discharge side of the pump should be $1\frac{1}{2}$ inches. The only hose necessary for use while a well is being sunk is a 50-foot length of 1-inch hose, although longer lengths can be used if necessary. The discharge port of the pump can be reduced to 1-inch size to accommodate the hose, and the female coupling on the washing nozzle previously referred to must accommodate the male coupling on this length of 1-inch hose.

The construction and assembly of the tank outfit, for convenience in transportation, should be that of a complete unit which can be slipped onto the bed of any truck or trailer capable of handling a 1-ton load. For convenience in the actual sinking of wells, the tank should be equipped with a catwalk and a ladderlike derrick to aid in handling heavy weights while they are suspended in the air. When the derrick is employed, a set of double hooks and a ring are used on a rope which is controlled by a small hand winch. The outfits used by the Michigan Department of Conservation are equipped with a small winch capable of handling 350 to 500 pounds, although the actual weight handled rarely exceeds 150 pounds. The use of a derrick is not necessary since every step in the establishment of a well can be done by means of manual methods; the use of a derrick simply makes the

work safer and more convenient, and it can be performed by a smaller crew.

Again the fact is mentioned that the use of a rotary pump is permissible for establish-

ing, but *never* for pumping from a well. The only pumps which are suitable for drafting water from wells are centrifugal pumps and piston or plunger pumps. The latter types



NOTE: For complete outfit include Drive Cap and weighted Driver.

FIGURE M-8.—Driven-well assembly. For complete outfit include drive cap and weighted driver.

are self-priming, but the centrifugal pumps must be equipped with a hand primer or a self-primer.

The *method* of establishing shallow wells is purely hydraulic and consists of a number of simple steps, all of which may be accomplished by manual means in extremely isolated places. The use of a power drilling rig is dispensed with. The Michigan Department of Conservation and the Lake States Forest Experiment Station have prepared a very complete and comprehensive treatise entitled "The Use of Shallow Wells in Forest Fire Suppression," which may be obtained upon request.

Shallow Driven-Well Assembly.

Standard well points can be used with a reasonable degree of satisfaction in providing water for power pumpers in areas affording a high water table.

The diagram and list of materials contained in figure M-8 provides sufficient information for obtaining and assembling the essential material and equipment necessities for a shallow driven well. In case an exceptionally large amount of water is desired, two well points can be driven some distance apart and coupled together in the manner shown in the diagram.

The pitcher pump is used only to clear out excessive grit and sediment immediately after the point is driven. It can also be used for priming the main suction line to the power unit before the power pump is started.

Hand Power Well-Drilling Outfit. (Index No. 117. Texas F. S.-X.)

The Texas Forest Service has designed a hand-power, shallow-well drilling outfit which is used to some extent in that State. The material used is chiefly wood and construction of the various parts appears relatively simple. The principle of the arrangement is along the lines of a regular heavy-duty boring machine. The drill bit is comprised of a short length of 10-inch single-strength pipe with cutting fins bolted in one end; the size can, of course, be varied. The drill stem is ordinary 4- by 4-inch timber. The derrick is made of 18-foot poles, tripod fashion, with a wooden windlass attachment.

This device is used principally for digging wells at lookout and fireguard stations rather than for suppression purposes.

The outfit can be constructed by anyone possessing a reasonable amount of mechanical ingenuity when provided with the specification.

Pump and Tank Trucks. (R5-X—R1-X.)

Many types of tank-truck pumpers have been designed and tested in an endeavor to determine the practicable limits of such units. Pumpers have been designed for various weight chassis from the 1/2-ton pickup size to the 5-ton chassis.

One-half or three-fourths-ton chassis do not provide a practical unit for tank-truck pumper service when the economics of the problem are considered in their relation to the result which can be achieved in a design of this class unit. Water is a severe load for any type chassis and field experience indicates that the lightweight units suffer from stresses which eventually break down the chassis. Comparable weights of other type loads do not so affect the chassis. Difficulty has been experienced in loosening of wheel spokes, excessive wear on wheel bearings and motor, and racking of body and frame members. Such wear results from loads which are well within the pay-load capacity of the chassis. It is simply that the inertia effect of a water load in movement is so severe that lightweight chassis will not withstand the strain.

A cardinal principle observed in the design of tank-truck pumpers is to limit the horsepower-weight ratios to a reasonable point. This means that the pay-load weight should be well within the limitations set up by the chassis capacity. A 1/2-ton chassis with pick-up body, pump, and accessory gear is loaded to its limit with a tank capacity of 60 gallons. The cost of such a unit is approximately \$800. There are no chassis of the lightweight type available in the 3/4-ton class which provide a better unit than the 1/2-ton chassis. The former usually are standard 1/2-ton units which have been equipped with sufficient tire capacity to carry three-fourths of a ton. However, the spring suspension has not been changed and deflection is too great to carry a rated load over rough roads.

A comparison of the 1/2-ton with the 1 1/2-ton unit indicates that for approximately three times the cost a dependable unit can be built which will embody all the features of a high-class pumper unit carrying a water load approximately four or five times that of the 1/2-ton unit. The larger pumper will carry such a load with comparative ease whereas the rated load for the 1/2-ton unit is a severe haul and causes excessive wear in all moving parts. The 1/2-ton unit, due to flexibility of its springs, lacks roadability. Flexing of tires aggravates this condition and operating speeds are reduced.

Larger tank-truck pumpers are built for special services only. Where larger and more powerful pumps and carrying capacity are required, a chassis is selected which will meet the particular need. A comparison of the large units with the 1 1/2-ton type leaves much in favor of the latter.

A brief description of the Region 5 1 1/2-ton size pump and tank truck (figs. M-9, M-10) follows. The Region 1 type is materially the same except for arrangement of some of the equipment (figs. M-11, M-12).

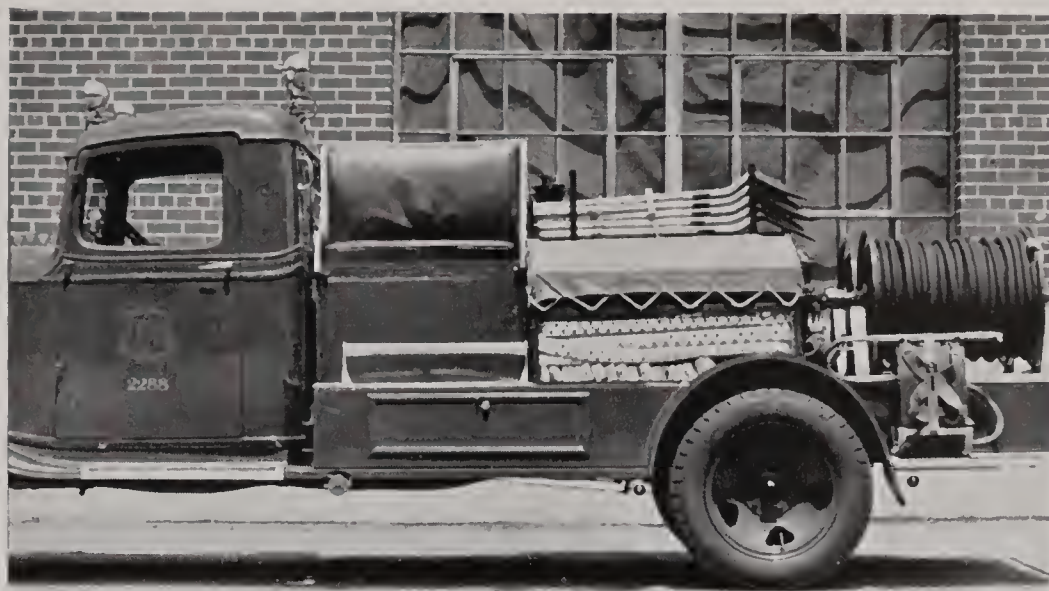


FIGURE M-9. Side view of Region 5 pump and tank truck.

Chassis.—Ford or Chevrolet 1½-ton or similar size unit.

Pump.—Two-stage centrifugal-type. Performance characteristics: 100 gallons per minute at no head to approximately 15 gallons per minute at 400 pounds pressure. Pump is equipped with a vacuum primer which is attached to the intake manifold and the pressure side of pump. The average automobile engine will develop approximately 17 inches of vacuum at sea level which is approximately equivalent to 21 feet draft. Suction lines extend to each side of truck at the rear of cab. Control valves are located in small compartment below foot rest on right side of truck and are easily reached through the top deck.

Cooling system.—Vacuum-tank fuel supply is installed to avoid gas lock. The fuel pump is converted to a water-circulating pump. Radiator is sealed and overflow line is connected from top of radiator to top of main water tank. Feed line runs from bottom of tank to fuel pump and thence to discharge end of motor head. Control valve is installed to dashboard. With such a circulating system in operation it is impossible to overheat motor under any operating condition. An auxiliary supply is provided by a feed line from the pressure side of pump through a control valve on the dashboard to the motor head for use when tank is empty and water is being drafted from an outside source.



FIGURE M-11.—Rear view of Region 1 type pump and tank truck.

Pipe system.—All pipe and valves on pressure side of pump are *extra strong grade*. One and one-half inch outlets are provided on each side immediately forward of the hose reels. A feeder from this line furnishes water to the hose reels.

Hose.—Three hundred to five hundred feet of 1,000-pound-test ¾-inch hose carried on each of the two reels mounted on rear of truck. The reels are of the live type. Five hundred feet of 1½-inch cotton-jacketed rubber-lined hose or 1,200 feet of linen hose is carried in hose baskets. Four 8-foot lengths of 2½-inch suction hose are carried in the compartment below the rear deck.

Tank.—Water tank carries 300 gallons and can be filled through opening in top or by the pump directly through the pipe system. Such filling does not interfere with operation of discharge

hose lines. Tank is of 16-gage, galvanized iron adequately baffled (same tank as index No. 347).

Pump drive.—Pump is driven by a heavy-duty power take-off on the transmission and a needle-point flexible shaft connection to the pump. The direct-ratio drive

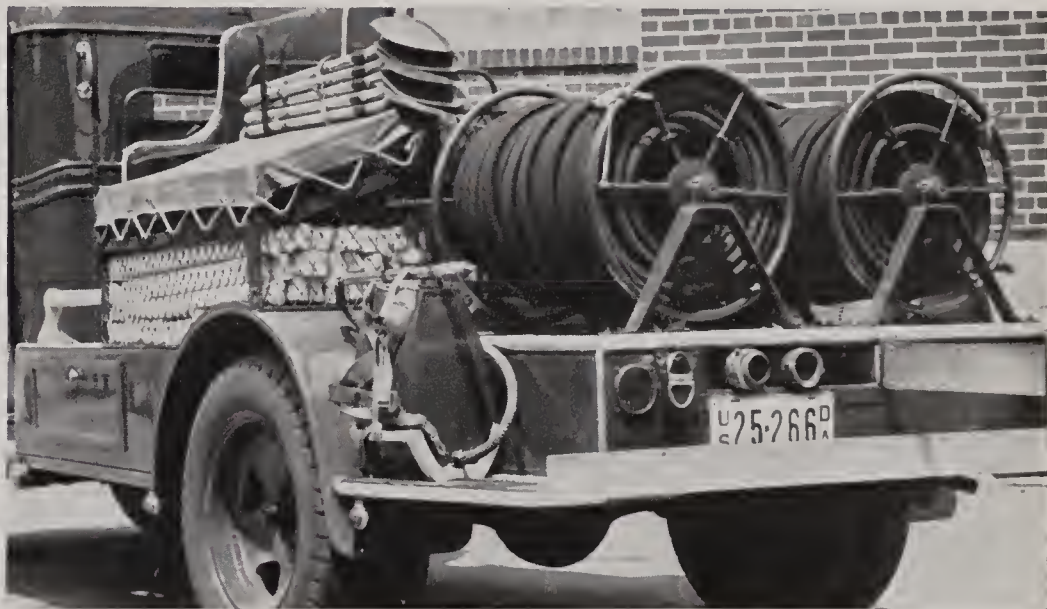


FIGURE M-10. Rear-end view of Region 5 pump and tank truck.

of the power take-off is stepped up to the pump through a speed increaser which is built in the pump housing.

Crew seats.—Seats are provided for four men at the rear of cab. Safety belts of the quick-release type are installed for these men.

Roadability.—The weight distribution of the unit is such that it can travel curves with a minimum of sway, the factor limiting speed on curves being the traction provided by the roadbed.

Weight, gross.—As equipped, 10,800 pounds.

Cost.—Complete as shown, about \$2,200 to \$2,500.

Complete constructional data and material lists may be secured from the Regional Forester, United States Forest Service, San Francisco, Calif.

Centrifugal-Type Power Take-off Pump. (Index No. 275.)

This is the type of pump most universally used with pump and



FIGURE M-12.—Front-side view of Region 1 type pump and tank truck.

tank-truck outfits as described under pump and tank trucks. The pump is quite versatile in that it has a wide range of gallonage and pressure delivery. It is capable of developing working pressures up to several hundred pounds per square inch. The pump is constructed to work on a power take-off from the transmission of the truck. Further information regarding the pump will be found under the description of pump and tank-truck equipment.

tight packing glands and is also provided with spring-cushioned cross bars upon which the hose is rolled. This spring-cushioning feature permits use of any length of hose without unreeling the entire length before starting to pump water through it, the hose expansion being taken up by the springs. This is the type of reel used on the pump and tank trucks. The reel has also been found useful in making up trailer-mounted pump units which contained live hose reel, a small portable pump, and light water tank.

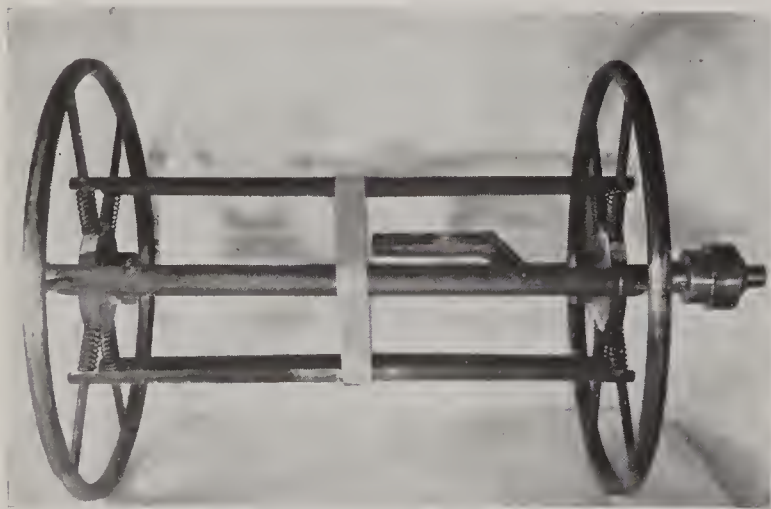


FIGURE M-13.—High-pressure live hose reel.

Live Hose Reel, High-Pressure. (Index No. MSF-295.)

This is a live hose reel (fig. M-13) constructed to withstand high working pressures. The capacity of the reel is approximately 500 feet of $\frac{3}{4}$ -inch high-pressure hose (index No. MSF-185). The reel is constructed with water-

Fire-Suppression Truck, $\frac{1}{2}$ -Ton Size. (State Forester, Raleigh, N. C.—X.)

The North Carolina Forest Service has designed a rather unique tool box, water tank, and manpower seating arrangement for use with pick-up type trucks. The tool boxes are built into the truck along both sides and are provided with hinged lids which form seats for the men. The lids open up from the outer edge toward the center. The boxes are also open at the rear end, where ready access to the tools may be had by simply lowering the truck endgate. The tank which is of metal and rectangular in shape, is fitted into the truck body across the front end. An outlet valve is provided at the side of the truck where backpack cans may be filled, or to which a pumper hose connection may be made. This makes a very desirable arrangement where a power-driven pump, either transmission or fan-belt-type, is installed in the truck itself. Figures



FIGURE M-14.—Rear-end view of 1/2-ton suppression truck.

M-14 and M-16 illustrate quite clearly the arrangement of the truck.

Suppression Truck Tool Box. (R9-X.)

Region 9 has designed a combination tool box and truck seat for use in converting their regular trucks into suppression crew trucks. The box can be constructed to various dimensions and of any suitable 3/4-inch No. 1 common lumber according to local requirements. The box is designed to set in the center of the truck bed and provide a double-row seat with back rests between. Figure M-16 illustrates the box quite clearly. In addition to the box, there will be noted the four-barrel arrangement used for transporting water to fill back-pack cans or to be used in connection with either a fan-belt- or transmission-type power take-off pump. In this particular instance, the truck is equipped with a fan-belt-type Panama pump.



FIGURE M-15.—Side view of 1/2-ton suppression truck, showing water-tank outlet.

Fire-Truck Loading Ladder. (Index No. 221.)

This ladder offers a simple, convenient, and safe means of access to the body of a truck without climbing over the stake panels or necessitating the removal of a panel from the rear end. It is very effective in preventing continuous disfigurement of the paint jobs and the panels themselves, when used as a ladder. The ladder is always attached to the truck and ready for immediate use. It neither increases the width of the truck nor affords any obstruction in backing the truck. This ladder can be constructed at little or no cost for materials by any camp blacksmith who may be furnished with the specification.



FIGURE M-16.—Suppression-crew tool box, seat, and water-barrel arrangement.

SECTION N
POWER PUMP ACCESSORIES

SECTION N

POWER PUMP ACCESSORIES

In order to derive maximum results from power pump equipment, especially that of the portable type, certain tools and accessories are necessary. In addition to the individual items of power pump accessories which appear hereinafter, the following lists of tools and accessories are suggested as constituting a minimum of both tools and accessories which should accompany any power pump unit regardless of size. Immediately following the tool and accessory lists will be found a brief description of the various types of power pump accessories for which specifications are available within the master file (unless contained within the write-up itself).

TOOLS

- | | |
|---|--------------------------------------|
| 1 Roll $\frac{3}{4}$ -inch friction tape. | 2 Starter cords. |
| 1 Funnel, filter type. | 1 Wrench, packing gland. |
| 1 Ball peen hammer, small. | 1 Extra set spark plugs. |
| 1 Oil measure, 1 pint. | 1 Set breaker-point adjusting tools. |
| 1 Pliers, 8-inch, automobile. | 1 Grease gun, if necessary. |
| 1 Screw driver, 6-inch, heavy-duty. | 1 Wrench, spark-plug, as required. |
| 1 Wrench, 6-inch, Crescent. | 1 Oil can, squirt type, as required. |
| 1 Wrench, 10-inch, Crescent. | 1 Instruction book. |
| 2 Wrenches, Spanner. | Grease and oil. |
| | Cleaning rags or cotton waste. |

ACCESSORIES

- | | |
|--|---|
| 1 Accessory box (container for tools and accessories). | 1 $1\frac{1}{2}$ - to 1-inch adapter coupling. |
| 2 Nozzles—with various size tips as required. | 1 5-gallon back-pack fuel tank, with $\frac{1}{2}$ -inch U. S. standard female outlet. |
| 2 Siamese control valves. | 1 5-foot length $\frac{1}{4}$ -inch gasoline hose with coupling— $\frac{1}{2}$ -inch U. S. standard male hose nipple. |
| 1 Pressure-relief check valve. | 1 Headlight, electric (refer to sec. D). |
| 6 Gaskets for nozzle tips. | 1 Board, pack, for pump unit (refer to sec. J.) |
| 6 Gaskets for nozzles. | |
| 24 Gaskets for $1\frac{1}{2}$ - and 1-inch hose as required. | |
| 2 8-foot lengths suction hose. | |
| 1 Strainer for suction hose. | |

Accessory Box, Metal. (Index No. 63.)

Region 5 uses a small metal container in which is contained the necessary tools and accessories pertaining to each portable power-pumper unit. A specification covering this container has been prepared. The box is made of 18-gage galvanized-iron sheeting and is in the form of a chest approximately 18 inches long, 10 inches wide, and 10 inches deep. This particular box is rather small and will not accommodate the suction hose or very many

extra accessories, other than the tools and accessories listed hereinbefore.

Suction Hose. (MSF-184.)

A noncollapsible steel-wire-inserted rubber hose for use with power pumpers. The hose is equipped with slotted forestry-type brass couplings. The standard specification provides for three sizes as required. $1\frac{1}{2}$, 2, and $2\frac{1}{2}$ inches, inside diameter, the length to be 8 feet unless otherwise specified. For the standard type of strainer to use with the suction hose, refer to the next item.

Strainer, Suction Hose. (Index No. MSF-332.)

The type of strainer adopted as standard is a bell-shaped metal casting threaded at the small end to the size required and the large end machined to accommodate a smooth screen-retainer ring. The screen which is of 22-gage copper wire, six meshes per inch, is held in place by the retainer ring, which in turn is secured to the main casting with six No. 10 32-thread brass machine screws.

Study of the various types of strainers indicates that this particular type is less susceptible to picking up grit, flotsam, etc., than other types when it is properly used. The proper method of using the strainer is to face the opening downstream if in running water and to support it from the bottom of the stream with small poles or a board. When used in still water, the strainer should be supported from the bottom in the same manner, or inverted so that it faces upward several inches below the surface of the water.

The specification provides for three sizes— $1\frac{1}{2}$, 2, and $2\frac{1}{2}$ inches—as required.

Shut-off Nozzle, 1-inch, I. P. T. (Index No. MSF-241-1.)

A shut-off nozzle of the floating-valve type having a 1-inch female parallel iron pipe threaded on the inlet and a $\frac{3}{4}$ -inch garden-hose thread for the tips (fig. N-1, 6). Tips are available in sizes from one-eighth to five-eighths of an inch by $\frac{1}{16}$ -inch graduations. Shut-off nozzles are of brass having a smooth-cast-finish. The 1-inch size is adopted as standard since it is rare that a tip size larger than five-eighths of an inch is used in field work and a 1-inch shut-off has a $\frac{3}{4}$ -inch bore. This creates a considerable saving in cost as compared to a $1\frac{1}{2}$ -inch size shut-off nozzle. Adoption of the 1-inch size permits interchangeable use of such nozzles for all regular size hose in field use. Inexpensive reducer couplings permit attachment to $1\frac{1}{2}$ -inch hose.

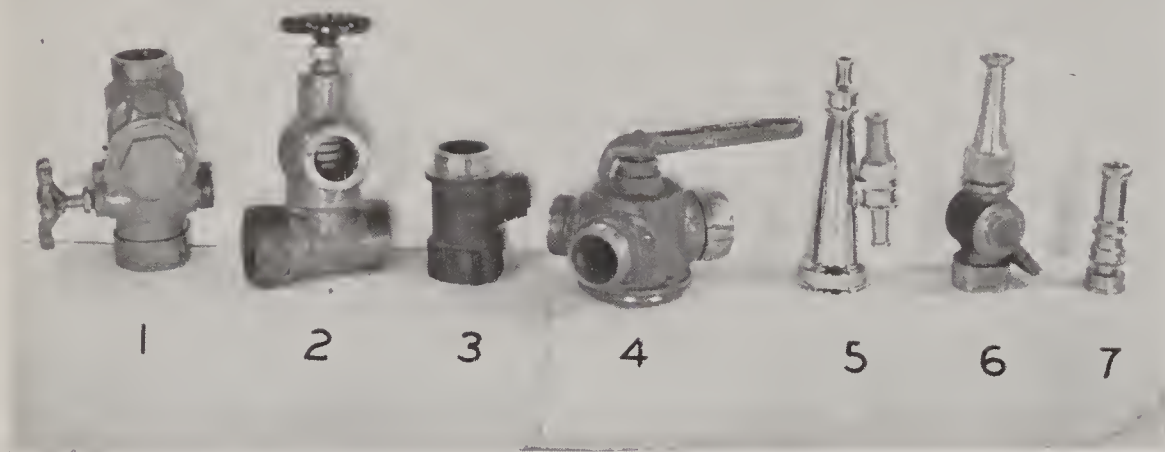


FIGURE N-1.—Power pump accessories: 1, Swinging check and bleeder valve; 2, pressure-relief check valve; 3, 1½-inch tee coupling with 1-inch take-off; 4, Siamese control valve; 5, screw-tip nozzle with extra tip carriers; 6, 1-inch shut-off nozzle with tip; 7, garden-hose nozzle.

Screw-Tip Nozzle with Extra Tip Carriers. (Index No. MSF-241-2.)

Suitable for portable power pumpers or other uses where a shut-off nozzle is not required (fig. N-1, 5). Constructed of corrosion resistant metal and having a holder to which can be attached two extra tips. Tip thread and size ranges are identical to that indicated for shut-off nozzle above. Constructed in the 1½-inch size only.

Garden Hose Nozzle. (Index No. MSF-241-4.)

A heavy-duty cast-brass garden-hose nozzle which is one of the most practical nozzle tips for use with the shut-off and screw-tip nozzles listed herein (fig. N-1, 1). The use of a garden-hose thread on all nozzle tips makes this a very satisfactory and efficient type of tip. The solid-pattern, coarse spray available with the garden-hose nozzle when used as a tip on the larger nozzle is one of the most effective available where a large coverage is desired with small volume; 80 to 100 pounds pressure is suitable for such work. By increasing the pressure to 150 pounds per square inch, a very effective fog-nozzle stream can be produced. Increasing the pressure to 250 pounds per square inch will produce a fog vapor comparable to that developed by any fog projector.

Siamese Control Valve. (Index No. MSF-380.)

The Siamese valve is designed to permit individual shut-off or opening of each discharge line (fig. N-1, 4). It is constructed with a female inlet and two male outlets having 1½-inch parallel iron-pipe threaded hose connections. Female connection is of the swivel type. Selective positions are indexed on the upper case of the valve body. Approximate weight 4 pounds.

Pressure-Relief Check Valve. (Index No. MSF-381.)

This device is suitable for installation next to the pump to provide a means of regulating

the pressures in the hose line (fig. N-1, 2). It consists of a brass body containing a female and male, 1½-inch iron pipe threaded for hose attachment and a spring-loaded pop valve, the tension of which is adjusted by a hand wheel. The relief valve may be set for practically any pressure from 50 to 300 pounds and will operate within rather close limits for the pressure to which it is set. Inlet or female connection is of the swivel type.

Swinging Checks and Bleeder Valve. (Index No. MSF-382.)

This unit consists of a brass body having a 1½-inch female and male parallel iron pipe threaded hose attachment (fig. N-1, 1). A swinging check valve is installed so that the pressure of a loaded hose line will be held by the check valve until the pump is again started. When starting, to relieve the pump load, a hand wheel is turned and a breeder valve permits the pump to discharge at the valve. Once pump speed is reached, the bleeder valve is closed and as the pressure is built up the swing check opens and permits the water to again enter the hose line. Inlet or female connection is forestry swivel type.

Reducer Coupling, 1½- to 1-inch, I. P. T. (Index No. MSF-104.)

An inexpensive type of machined brass reducer coupling adaptable for use with 1½-inch fire hose where a 1-inch fire hose with 1-inch shut-off type nozzle is to be used. The coupling is parallel iron pipe threaded throughout. The edges are knurled to form a better grip.

Tee Coupling, 1½-inch with 1-inch Outlet. (Index No. MSF-103.)

This unit consists of a brass casting having a male and female 1½-inch parallel iron pipe threaded and a 1-inch parallel iron pipe threaded hose nipple (fig. N-1, 3). The device is intended for insertion at some intermediate point in a 1½-inch hose line to provide a take-off for a 1-inch hose.

Gaskets, All Kinds. (Index No. MSF-151-S.)

Gaskets for 1½-inch iron pipe threaded fire-hose couplings to consist of a tread-stock ring 2 inches outside diameter by 1⅞ inches inside diameter by one-eighth inch thick.

Gaskets for 1- and ¾-inch iron pipe threaded fire-hose couplings. This should specify tread stock and should indicate the particular size

required for the particular hose coupling to be used. No uniformity exists in these sizes.

Gaskets for $\frac{3}{4}$ -inch nozzle tips to consist of standard tread stock for $\frac{3}{4}$ -inch garden-hose size.

Fuel line and tank.—The power pumper specification (index No. MSF-273) contains a specification for a very satisfactory type of metallic-braid-covered gasoline hose, the outer end of which is provided with a coupling adaptable to the standard back-pack water can. The standard back-pack water can (index No. MSF-79) makes a very satisfactory fuel tank for portable power pumpers. The new portable power pumper specification contemplates the use of this type of fuel supply tank.

Funnel, Filter Type. (Index No. 144-S.)

There is a real need for screen filters in funnels used for gasoline lanterns, portable pumpers, and other gasoline-burning devices. If fine-mesh filters are not commercially available, a very efficient filter funnel can be made by soldering in the large end of the funnel spout a screen of *200- to 250-mesh monel screen cloth*. This material may be secured from copper and brass manufacturers or from the Supply Depot. A 250-mesh screen will filter gasoline but will hold water from passing through. Funnels supplied with gasoline lamps, lanterns, and portable power pumping or grinding equipment should always be of this type in order to avoid plugged feed lines or faulty feeding or carburetion.

Headlights. (Refer to sec. D, index No. MSF-178.)

Couplings, 1½-inch, 1-inch, and ¾-inch Fire Hose.

Forestry-type, slotted, swivel-ring couplings are made of a corrosion-resistant aluminum alloy which produces a strong yet lightweight product. Such couplings have an approximate weight of 11 ounces per set. Aluminum alloy couplings are not subject to injury from dropping as are brass couplings. Iron-pipe threaded couplings, which are standard for the Forest Service, are 1½-inch, iron-pipe size and have a parallel thread. They should not be referred to as having a 1½-inch fire-hose thread. All standard fire-hose threads are of special design and size and are of a uniformly greater diameter than a comparable iron-pipe size. As an illustration, 1¼-inch fire-hose thread is practically the same size in diameter and thread pitch as 1½-inch iron-pipe thread, and if the thread is short, the two types can be coupled together.

Forestry-type, slotted swivel-ring couplings of brass in the 1-inch size are used to couple 1-inch cotton-jacketed rubber-lined and hard-rubber hose in the 1-inch and ¾-inch sizes. The specification for ¾-inch high pressure hose requires an outside diameter which fits a

1-inch coupling; therefore the latter is used for hose of this type.

The specification for hose couplings is incorporated in the hose specification in each instance. Couplings are rarely purchased separately as it is impracticable to recouple old hose.

Pack Boards. (Refer to sec. J, Back-packing equipment.)

Pack Bag for Linen Hose. (Index No. 56-2-S.)

Where linen fire hose is used, a pack bag attached to any type of pack board will be found to be a very efficient means of transporting and laying out the hose. The hose should be folded back and forth into the bag, starting with the male coupling down. In this manner, when the bag is filled the hose may be readily carried to point of laying out, where the female coupling may be attached. The person carrying the hose simply walks along while the hose plays out without attention. With a little special work, a leather-reinforced opening may be put into the upper side of the packsack as shown in figure N-12. This facilitates playing out the hose still further. The ordinary pack-board bag (index No. 56-1) will hold approximately 400 feet of hose when properly laid up.

The bag shown in the accompanying illustration is one which is now commercially manufactured by the Pacific Marine Supply Co., Seattle, Wash. No specification other than the description given herein has been prepared for this particular item, due to its simplicity.



FIGURE N-2.—Linen hose pack bag.

Special Lightweight, 1½-inch, CJRL Hose. (Index No. MSF-182-1.)

Cotton-jacketed rubber-lined hose of the 1½-inch size comes in 50-foot lengths. The approximate weight per 50-foot length, coupled, is 15 pounds. The diameter of a 50-foot length of hose when rolled is approximately 20 inches. The Forest Service type aluminum-alloyed coupling described hereinbefore is required.



FIGURE N-3. 1. 100 feet of linen hose; 2. 50 feet of cotton-jacketed rubber-lined hose. Both 1½-inch size.

The specification provides for an entirely serviceable type of hose adaptable to rough usage and heavy duty. The minimum pressure-burst requirement of this hose is 600 pounds.

Special Lightweight, 1-inch, CJRL Hose. (Index No. MSF-182-2.)

The specification covering this type of hose provides a hose materially the same as 1½-inch cotton-jacketed rubber-lined hose except for the smaller diameter and, of course, less weight (fig. N-3, 2).

Mildew-Proof, 1½-inch, Linen Hose. (Index No. MSF-183.)

The hose provided by this specification is thoroughly mildew proof and is constructed

to withstand rough usage and heavy duty at high working pressures without excessive leakage (fig. N-3, 1). It is coupled in 100-foot lengths unless 50-foot lengths are specifically requested. The standard Forest Service type of aluminum coupling is used.

Linen hose weighs approximately 13 pounds to the 100-foot length, coupled, and constitutes about one-fourth the bulk of cotton-jacketed rubber-lined hose of the same size. This type of hose is particularly useful where back-pack transportation is necessary. The cost is approximately the same as for cotton-jacketed rubber-lined hose.



FIGURE N-4.—Side view of hose-drying tower.

Noncollapsible, Laid-Wrapped Hose, ¾-inch. (Index No. MSF-185.)

This is heavy-duty noncollapsible water hose of laid-wrapped construction to withstand exceptionally high working pressures. This hose is constructed to withstand a hydrostatic pressure of 1,000 pounds per square inch without leakage, undue distortion, or slippage of couplings. The couplings used are of brass but patterned after the standard Forest Service type of coupling. The weight of this hose is 25 pounds per 50-foot length, coupled.

Hose-drying Tower. (Index No. 363. Los Angeles Co. Forester—X.)

The hose-drying tower, for which specification is available, was designed and is used by the Los Angeles County Forestry Department of southern California. It consists of a tower constructed of iron pipe approximately 30 feet in height, at the top of which are pegs or brackets for holding a given number of lengths of hose (figs. N-4, N-5). This arrangement permits the hose to be suspended and exposed to the air upon all sides for drying, each length being suspended at the center. A sort of block and tackle arrangement is used to hoist the hose to the top where it is hooked in place. The width of the hose tower can, of course, be varied to accommodate any desired number of lengths of hose at one time, the average size

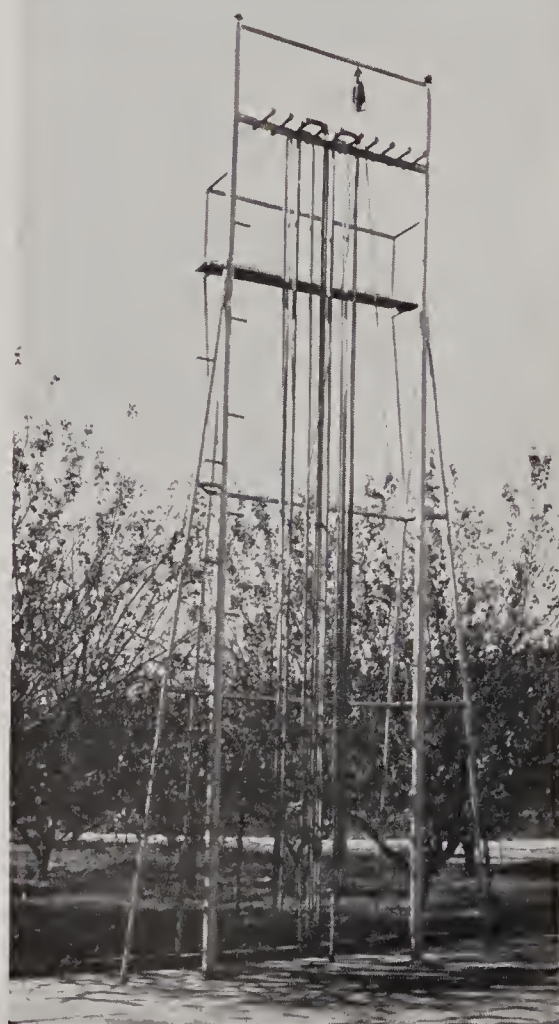


FIGURE N-5.—Front view of hose-drying tower.

tower being one which will accommodate 20 lengths, or 1,000 feet of hose at one time.

The construction of the tower is rather simple, and can be done by anyone possessing a little mechanical skill when furnished with the specification and the required material, which is principally ordinary iron pipe.

Hose Roll-up Reel.

A convenient home-made device for rolling 1½-inch fire hose. Consists of a wood disk, with core, shaft, and crank, mounted on a suitable wood stand.

Figure N-6 illustrates clearly the manner of construction and materials to be used.

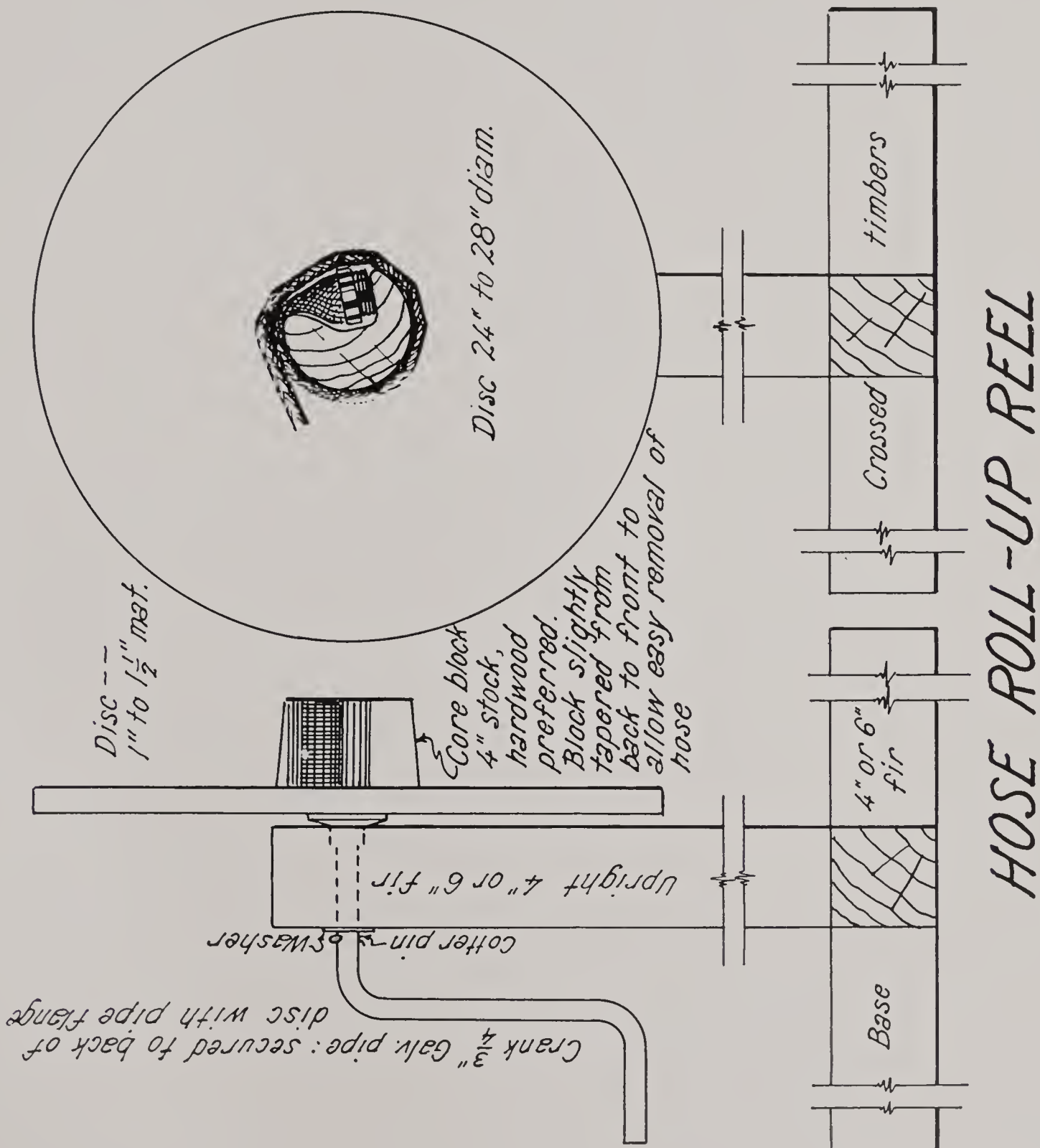


FIGURE N-6.—Hose roll-up reel.

SECTION 0

WATER-TRANSPORTING EQUIPMENT AND CONTAINERS

SECTION O

WATER-TRANSPORTING EQUIPMENT AND CONTAINERS

Canvas Bucket. (Refer to sec. E, Camp equipment.)

Water Bags, 2- and 5-gallon Sizes. (Index No. MSF-35.)

The standard water bags for Forest Service use are manufactured from first-class flax duck and are available in two sizes (fig. O-1, 2, 3). Both the 2- and 5-gallon sizes are provided with rope handles so that the bag hangs the long way up and down. Each bag is provided with a suitable metal filler vent and cork. Dimensions of the 2-gallon bag are approximately 12 by 16 inches. Dimensions of the 5-gallon bag are approximately 16 by 24 inches.

Canteens, 1-, 2-, 4-, and 8-quart Sizes. (Index No. MSF-83.)

The standard canteen is the round-type galvanized-iron canteen made in either 1-, 2-, 4-, or 8-quart size as required (fig. O-1, 4, 5, 6, 7).



FIGURE O-1.—1, Five-gallon man-pack water bag; 2, 5-gallon water bag; 3, 2-gallon water bag; 4, 8-quart canteen; 5, 4-quart canteen; 6, 2-quart canteen; 7, 1-quart canteen.

Each canteen is covered with blanket material and recovered with khaki duck. It is provided with a shoulder or carrying strap which is securely fastened to the canteen by metal loops. The 4-quart size canteen is $9\frac{1}{4}$ inches in diameter by $4\frac{1}{8}$ inches thick. The 1-, 2-, and 8-quart sizes are directly proportional according to capacity. The filler vent in all four sizes is the same so that canteen tops and gaskets are interchangeable.

Canteen-top Gasket. (Index No. MSF-152-S.)

The standard type of canteen-top gasket best adapted to use with canteens which are used to carry drinking water, etc., can be procured upon the following specification:

Specification.—Gaskets to consist of a semi-soft fiber composition in disk form $1\frac{1}{2}$ inches in diameter by one-sixteenth inch thick. Gasket to be thoroughly waterproof and of a composition which will not peel, wrinkle, or impart injurious or distasteful properties to drinking water.

Man-pack Water Bag, 5-Gallon Size. (Index No. MSF-37.)

The 5-gallon, man-pack water bag is a desirable piece of equipment for use in connection with fire-control work where it is necessary to pack water for considerable distance either for drinking purposes or for actual fire-suppression work (fig. O-1, 1). The bag part of the man-pack is constructed of first-class flax duck and is approximately 16 by 24 inches in size. This bag is attached at the sides and top to a piece of thoroughly waterproofed canvas approximately 16 by 40 inches in size, to which is securely fastened the web shoulder straps for carrying the bag. The bag is provided with a compression bib outlet having a $\frac{1}{2}$ -inch standard hose nipple 2 inches in length which is suitable for the attachment of a hand-pump hose for suppression work. Each bag is provided with two metal filler vents and two corks attached to the bag by a heavy string. When not in use the bag can be rolled into a small, compact bundle. Before rolling for storage for any length of time back-pack water bags, as well as other types of fabric water bags, should be thoroughly dried since, if rolled while wet and stored where they cannot readily dry out, they will mildew, thus deteriorating the fabric and causing them to leak.

Rubber-insert Water Bag. (Index No. MSF-33.)

The rubber-insert water bag is designed for use in connection with a standard size knapsack (fig. O-2). It is constructed of highest quality sheet rubber and is approximately 13 inches wide by $14\frac{1}{2}$ inches in length and $4\frac{1}{2}$ inches in depth. It is provided with two baffle partitions to assist the bag in holding its shape when filled. It is provided with a 2-inch screw cap and collar filler vent at the top and a standard $\frac{1}{2}$ -inch drain cock at the bottom which is equipped with a standard combination $\frac{3}{8}$ - to $\frac{1}{2}$ -inch hose nipple.

All that is necessary to use this type of bag for transporting water is to cut a small hole in the bottom of a knapsack to accommodate the outlet drain cock. The bag can be used either for transporting drinking water or in connection with the standard type of hand

pump, the hose being readily attachable to the combination nipple provided. The capacity of the bag is approximately 5 gallons and its weight when empty is about 2½ pounds. The standard knapsack specification contains a pro-



FIGURE O-2.—Rubber-insert water bag (standard combination ½- to ¾-inch hose nipple not shown).

viso under which knapsacks may be procured which have the special outlet hole cut in the bottom and covered by a hinged flap for use with the rubber-insert water bag.

Back-Pack Can, 5-Gallon.

Refer to section L, Hand pump equipment, for full details concerning the standard 5-gallon back-pack can for use in connection with hand pump, flame thrower, etc.

Carriers, 5-Gallon Back-Pack Can.

Refer to section R, transportation equipment, vehicular, for full details and description of the standard carrier for transporting the standard 5-gallon back-pack can on automobile running boards or the sides of truck bodies.

Milk Cans, 5- and 10-Gallon Sizes. (Index No. MSF-80.)

The standard type of milk can often proves useful in fire-control work for transporting drinking water, food, etc. The specification

provides either a 5-gallon or 10-gallon size milk can of first-grade construction and of sufficient weight to withstand heavy service and rough use.

Five-Gallon Water Can, Horse or Truck Transporting. (Index No. MSF-81.)

The standard horse or truck transporting water can is constructed from 24-gage galvanized iron. It is rectangular in shape and approximately 11½ by 7½ inches by 14½ inches high; approximate capacity 5 gallons. The can is provided with a galvanized-iron loop handle and a 2-inch brass filler collar and screw cap. The cap is provided with an oil-and-water-resistant gasket. This can is particularly suited to the transportation of water, oil, or any other liquid either by horse packing or truck or automobile transporting. It is sturd-

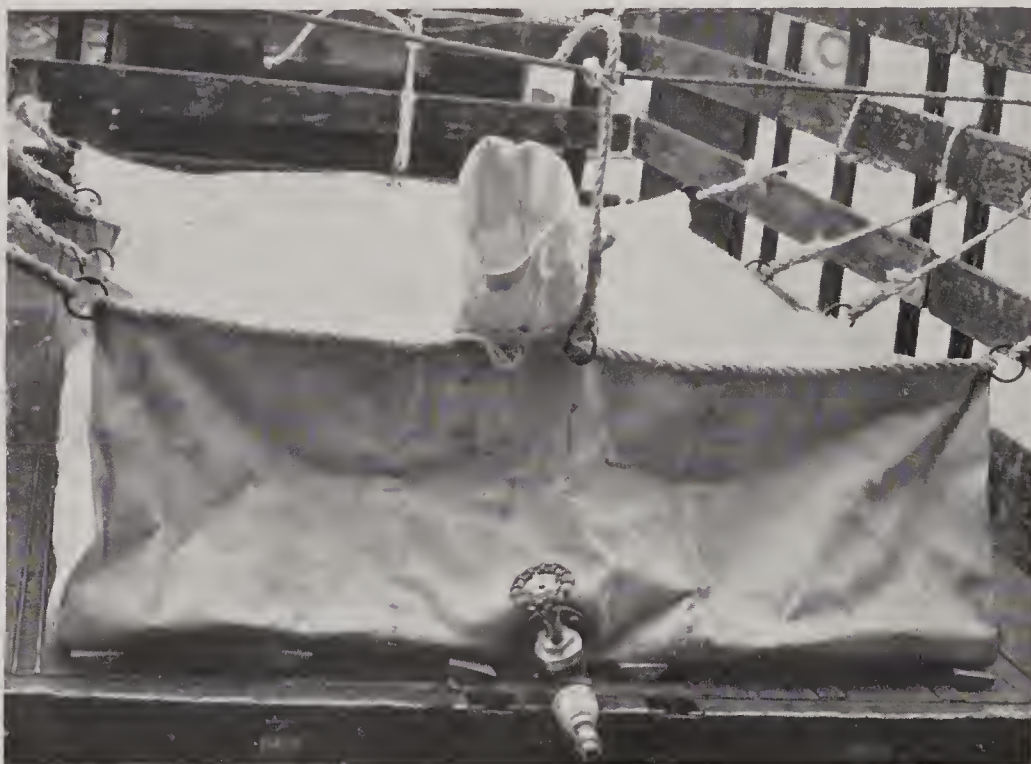


FIGURE O-3.—Canvas water tank in place in truck bed ready for filling.

ily constructed with reinforced bottom and is entirely suitable to withstand exceptionally rough handling. (Refer to sec. Q, Transportation equipment, index No. MSF-87, or MSF-87-1, for illustration of the water can.)

Horizontal-Type Carrier for 5-Gallon Water Can (for horse transportation).

Vertical-Type Carrier for 5-Gallon Water Can (for horse transportation).

Refer to section Q, Transportation equipment, animal pack, for full details and illustrations of the two types of carriers suitable for use with the 5-gallon water can for pack transportation purposes.

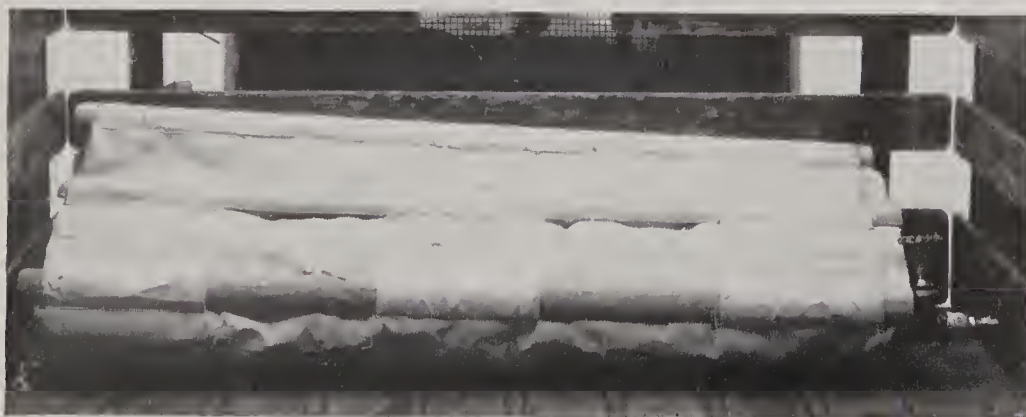


FIGURE O-4.—Canvas water tank rolled up.

Collapsible, Canvas Water Tank. (Index No. 345.)

The collapsible canvas water tank is constructed of thoroughly waterproof, No. 2-0 heavy duck and is thoroughly reinforced throughout where needed (figs. O-3, O-4). The approximate dimensions of the finished tank are about 72 by 60 by 20 inches and the capacity is about three hundred and fifty gallons. The bottom of the tank is reinforced with 6½-by 3-inch hardwood slats which are inserted into canvas sleeves to assist in shaping and stiffening the tank when in use. A 12-inch filler vent is provided at the top center at the rear end which is closed by means of a drawstring through a canvas neck projecting about 12 inches above the top of the tank.

A ½-inch rope reinforcing is provided entirely around the top of the tank, to which are fastened stay ropes at each corner and at the center of the sides and ends of the tank. These stay ropes are for use in tying the tank out to the sides and ends of a truck, or to stakes or trees when the tank is used as a supply reservoir upon the ground.

The interior of the tank is bisected by a sufficient number of laced-in baffles to keep the water from shifting and thus making of the loaded tank a more stable load when on a truck and in transit.

There is a 1½-inch iron-pipe outlet and gate valve provided at the rear of the tank at the bottom center.

This particular type of tank can be handled easily by one man and is particularly adaptable to use for transporting water in almost any type of truck having a bed 5 by 6 feet in size or larger. The tank is also very useful as a storage place for water in dry fire camps where water is packed in on pack animals. It is also quite possible to transport this tank by airplane, dropping it at any given location where needed simply by removing the hardwood reinforcing slats from the sleeves in the bottom so that they will not break and cause splinters to pierce the tank.

Demountable, Steel Water Tank. (Index No. 347.)

The demountable, steel water tank can be obtained in capacities ranging from 100 gallons to 500 gallons by 100-gallon graduations. It is constructed from 16-gage galvanized iron, all seams throughout being riveted and soldered. The tank is rectangular in shape to facilitate adjustment to any particular type of truck or trailer bed. It is provided with a sufficient number of baffle partitions to preclude excessive inertia effect from the water when in transit and loaded.

This particular type of tank is the one which is used on most of the pump- and tank-truck equipment used in the western Regions.

The weight of the tank and its shape make it quite possible for one or two men to load

even the 500-gallon size without too much difficulty, and the 300-gallon size or smaller can quite readily be loaded anywhere by one man.

The outlets provided in the tank, one at the rear end, left-hand corner, and one at the center bottom, may, of course, be rearranged to accommodate local requirements.

In using this type of water tank it is suggested that wooden hold-down bars with hook, chain, and eye-bolt fasteners always be used to hold the tank in a steady position on the truck bed. Cross timbers should never be used beneath this tank. It should set perfectly flat upon the truck bed at all times and should be securely fastened to prevent shifting since excessive shifting may wear through the material.

Steel Tank, for Aerial Delivery. (Index No. 346.)

The steel tank for delivering liquids from an airplane to the ground is constructed of two molded pieces of seamless steel which are



FIGURE O-5.—Aerial delivery water tank.

welded together in the center (fig. O-5). The tank is approximately 32 inches in length by 10½ inches in diameter, and is provided with a ¼-inch round-iron handle at one end and a filler vent and standard iron-pipe plug at the other. The capacity of the tank is approximately 10 gallons.

This particular item is specially designed for delivering water or oil from an airplane to the ground without requiring the aid of a parachute.

The approximate weight of the tank when empty is 23 pounds.

SECTION P
FIRE-LINE PLOW AND POWER EQUIPMENT

SECTION P

FIRE-LINE PLOW AND POWER EQUIPMENT

Reversible Sidehill Plows. (R1-X.)

Due to the fact that most of the Forest Service Regions using horse-drawn plows already have an ample stock of them on hand, no detailed specifications covering this particular item have been prepared. For the information of those who wish to obtain a suitable plow for fire-line work, the Western Regions have



FIGURE P-1.—Reversible sidehill plow.

found that the two-way reversible sidehill plow is the one which most nearly meets all requirements. The McCormick-Deering No. 209 or the Oliver No. 155 plows will be found to fulfill fire-line construction requirements quite satisfactorily. The two-horse size plow should be used, even though drawn only by a single horse, since it is less susceptible to breakage when subjected to rough going. Both of the plows recommended are of the take-down type. Figure P-1 illustrates the Oliver No. 155 ready for packaging for horse transportation.

Horse Plow Units.

Region 1 employs what are termed "horse plow units" in fire-control work. Where such units are maintained, they consist of one of the following lists of items, either of which provides a satisfactory unit ready for immediate transportation to a going fire. Where a first-class outfit is desired, the No. 1 unit is maintained. At locations where only the plow equipment is kept intact and pick-up horses are to be used, the No. 2 unit is maintained.

Plow Unit Equipment No. 1

- | | |
|----------------------|--------------------------|
| 2 Bags, nose, large. | 2 Water buckets, canvas. |
| 2 Blankets, saddle. | 4 Butt chains, long. |
| 1 Brush, currying. | |

- | | |
|---|---|
| 1 1-gallon canteen. | 1 Pair handles, plow, extra. |
| 1 Chain, log, $\frac{5}{16}$ inch by 20 feet, decking with two hooks. | 4 Pair handles, saw, crosscut. |
| 1 Clevis with grab hook to catch $\frac{5}{16}$ -inch chain. | 1 Kit, veterinary. |
| 1 Currycomb. | 12 Links, open, cold-shut. |
| 2 Goggles, horse. | 1 Lantern, gasoline. |
| 4 Hammers, single-jack. | 4 Mantas, pack covers. |
| | 2 Pads, packsaddle. |
| | 1 Pair pliers. |
| | 2 Harness and packsaddle combinations complete with collars, bridles, and halters fitted to horses. |
| | 1 Plow, reversible side-hill, taken down and cargoed for packing. |
| | 1 Plow, complete, set up ready for roadside plowing. |
| | 2 Plowshares, extra. |
| | 1 Plow bolt set, extra, complete. |
| | 4 Ropes, cargo. |
| | 25-foot rope, $\frac{3}{4}$ -inch, to tie horses in truck for hauling. |
| | 4 Saws, crosscut, $5\frac{1}{2}$ -foot. |
| | 2 Singletrees, very heavy. |
| | 5 Pulaski tools, sheathed. |
| | 1 Wagon sheet. |
| | 8 Wedges, falling. |
| | 1 Wrench, 8-inch, monkey. |
| | 1 Wrench, special bolt. |
| | 1 Wrench, plow. |
| | 2 Draft horses. |

NOTE.—The pack containing the plow should also contain 2 singletrees, 1 chain, 1 clevis, 2 open cold-shut links, 1 monkey wrench, 1 plow wrench, 1

pair pliers, 2 butt chains, and about 20 feet of hay wire or No. 12 wire.

A second pack should consist of 80 pounds of baled hay, 50 pounds of oats, nose bags, currycomb, veterinary kit, 1 canteen, and 2 canvas buckets.

The harness and saddles will be placed on the team and they will be expected to pack their loads to the fire.

Plow Unit Equipment No. 2

- | | |
|--|-----------------------------------|
| 2 Blankets, saddle. | 1 Plow bolt set, extra, complete. |
| 1 Water bucket, canvas. | 1 Wrench, monkey, 8-inch. |
| 1 Chain, log, light steel, tested, with two hooks. | 1 Wrench, plow. |
| 4 Chains, butt. | 1 Wrench, special bolt. |
| 1 Clevis, with grab hook to fit chain. | 4 Mantas, pack. |
| 12 Links, open, cold-shut. | 4 Ropes, cargo. |
| 1 Plow, reversible side-hill. | 2 Bags, nose. |
| 1 Plowshare, extra. | 80 Pounds hay, baled. |
| | 50 Pounds oats. |

Supplemental Equipment Suggested

- | | |
|------------------------------------|-----------------------------|
| 4 Bags, water, 5-gallon, man pack. | 1 Lantern, gasoline. |
| 2 Hammers, single-jack. | 1 Outfit, horseshoeing. |
| 1 Pair handles, plow, extra. | 1 Peavy, lightweight. |
| 2 Pair handles, saw, crosscut. | 2 Saws, crosscut, falling. |
| 1 Kit, first aid. | 2 Shovels, ladies'. |
| 1 Kit, veterinarian. | 2 Tools, Pulaski, sheathed. |
| | 2 Wedges, falling. |



FIGURE P-2.—Region 1 standard plow outfit.

Figure P-2 illustrates the standard Region 1 plow outfit minus the hay, oats, harness-packsaddle combination, and horses. At the right of the illustration will be seen the plow bundle cargoed and ready for packing.

Harness and Packsaddle Combination. (Index No. 176. R1-X.)

The harness and saddle combination consists of a heavy-duty harness combined with a

large-size Decker packsaddle (fig. P-3). This item is so designed that both harness and packsaddle are provided for either pulling a plow in fire-line construction work or packing the plow to and from the job. The saddle part of the combination has an extra large tree adaptable to heavy draft-type work horses. The specification includes everything necessary but the collar and saddle pads.

Since Region 1 is the originator of the harness-packsaddle combination, and is in a position to supply them upon reasonable notice, it is recommended that Forest Service units interested in this particular type of equipment and desiring to purchase it do so through Region 1 procurement division, in order that suitable equipment will be insured.

Plow Harness, Heavy-duty.
(R1-X.)

Region 1 has found through experience that where the fire-line plow work is exceptionally heavy and in rough going, the harness-saddle combination does not work out too well. The main difficulty with this combination is that

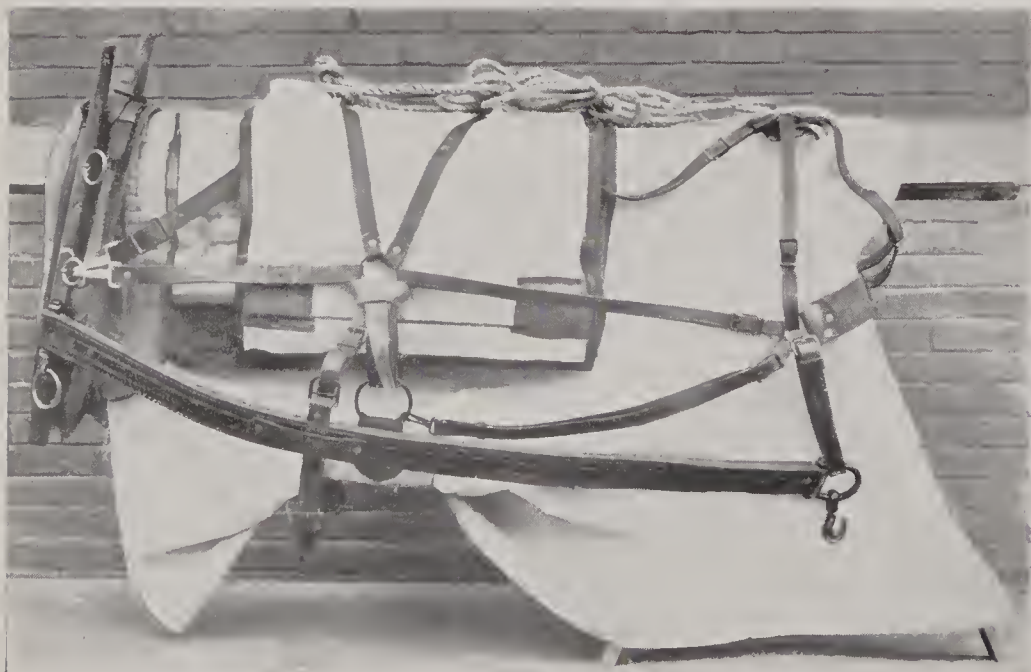


FIGURE P-3.—Combination plow harness and packsaddle.

where it is used for straight draft work for a full day at a time, the saddle tends to gall the horse, unless extreme care is used in arranging the saddle pad and blanket and the saddle cinch is allowed to be as loose as practicable.

In certain localities where they maintain heavy-duty plow units, the region uses a

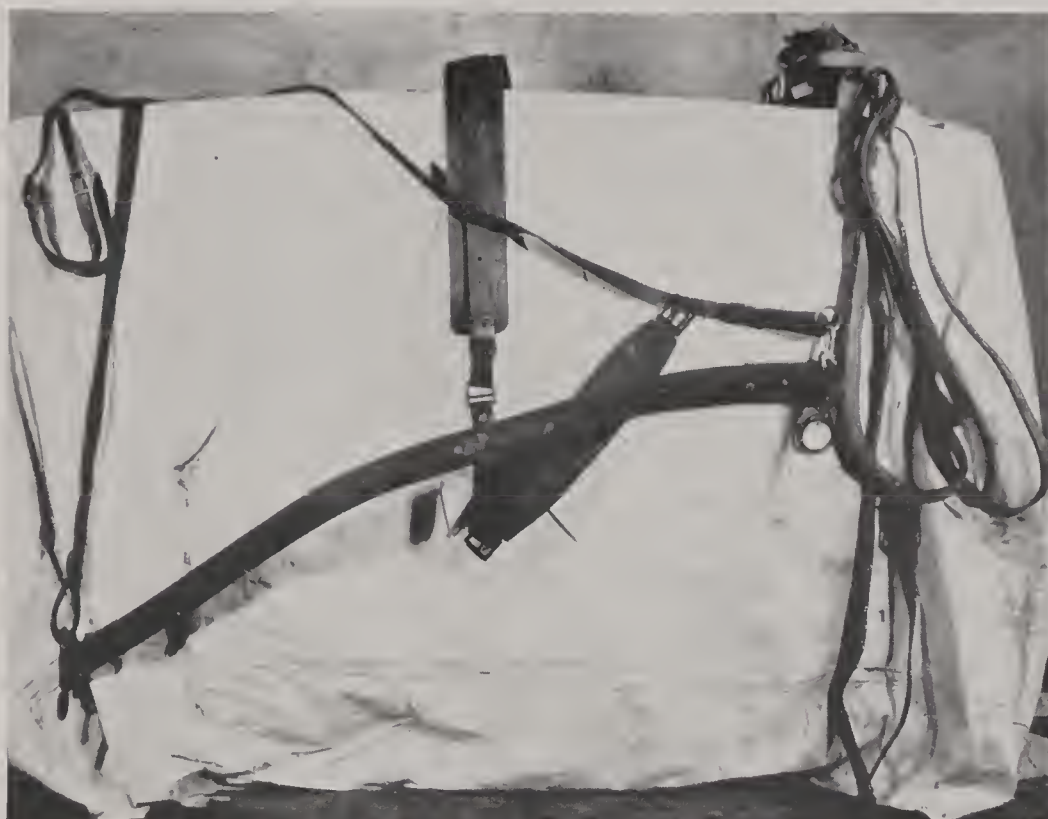


FIGURE P-4.—R-1 type heavy-duty plow harness.

straight skeleton type of plow harness (fig. P-4). This harness, as illustrated, consists of nothing more than hames, tugs, back and belly band, back and hip straps, and crouper. Lines and bridle complete the outfit if the horse is to be driven; if the horse is to be led, a blinker halter may be used.

Power-Driven Saw. (R1-X & R1-P.)

In 1934, Region 1 began using power saws in connection with fire-line construction work-

and other timber-felling and sawing work. Since that time the region has been experimenting with and developing the Wolf portable timber-sawing machine, which is manufactured by the Reed-Prentice Corporation (fig. P-5). This is a chain-type saw. The machine is equipped with a 5-horsepower four-cycle air-cooled Reed-Prentice motor weighing 47 pounds. The entire unit weighs 85 pounds.

During the period of development, Region 1 has perfected this particular machine to a point where it has reached a stage of practicability for use in connection with fire-line construction work. It is, of course, like all other high-powered lightweight portable machines, rather temperamental in operation. Therefore, when used under emergency conditions, it should be handled by qualified and experienced operators to obtain maximum results. Comparative tests have shown that the power saw is superior in rate of work to several gangs of sawyers using hand crosscut saws.

It is necessary to re-work the machine as it is obtained commercially to some extent before it is suited for use in connection with

fire-control work. However, the changes necessary are somewhat minor and can easily be accomplished by an experienced mechanic.

Region 1 has purchased several of these machines for other Regions and outside agencies. Probably Forest Service units desiring machines of this type should procure them through Region 1. This is the only power-driven saw suitable for forest fire-control work since it is light enough to be moved about without mounting on wheels.

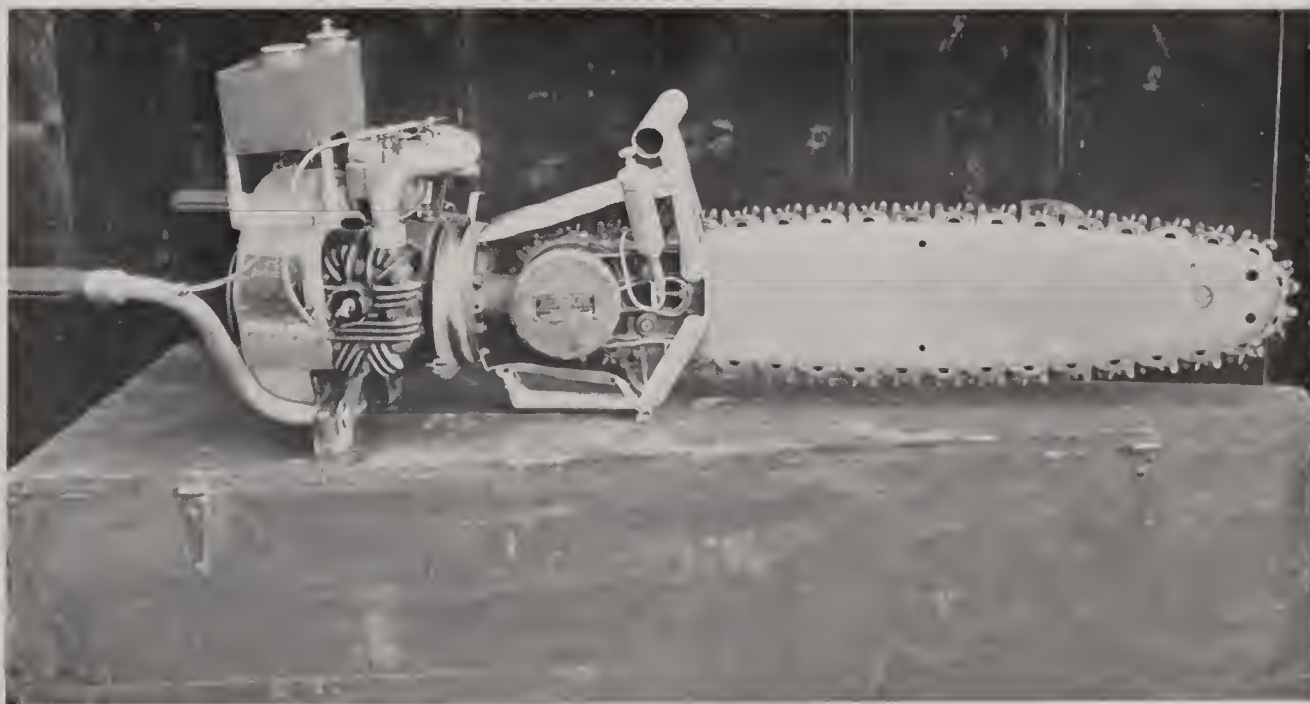


FIGURE P-5.—Wolf chain saw as reconditioned by Region 1, together with transporting box.

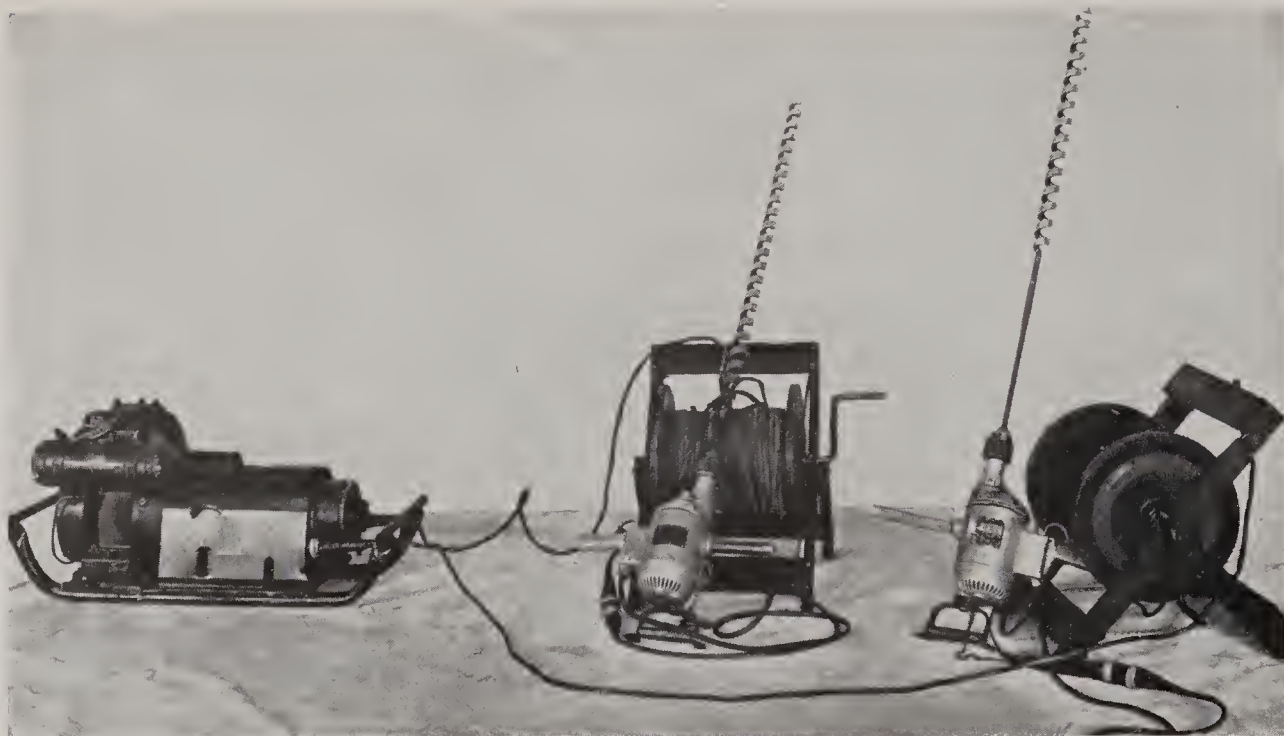


FIGURE P-6.—Snag-boring outfit.

Snag-Boring Machine. (R6-X.)

This is a portable gasoline-electric machine designed for boring holes in snags so that they can be felled with dynamite or by burning. The complete outfit consists of 1-kilowatt 125-volt direct-current generator directly coupled to a 11 $\frac{1}{4}$ -horsepower four-cycle air-cooled engine; two pay-out reels, each carrying 500 feet of twin conductor, with suitable brushes for constant contact; two standard $\frac{1}{2}$ - or $\frac{5}{8}$ -inch electric drills with reversing switch; and five or more 1 $\frac{1}{8}$ -inch barefoot augers 48 inches long with 36- to 40-inch worm (fig. P-6). The engine and generator are mounted on pipe runners with handles for easy transportation by two men. The engine-generator unit weighs 118 pounds and is separable for packing.

The advantage of a machine of this kind in fire suppression is the saving of time in felling large snags. With this equipment holes can be bored at a rate of 45 to 50 inches per minute, and with a trained crew large snags can be bored and blasted much more rapidly than they can be felled by hand methods. Disadvantages are relatively high cost of operation, lack of trained crews, inconvenience of transportation in rough topography, and difficulty of handling in heavy reproduction of brush. The weights of the various component parts of the unit are as follows:

	Pounds
Engine and generator (separable for packing)----	118
Two $\frac{1}{2}$ - or $\frac{5}{8}$ -inch drills, 18 $\frac{1}{2}$ pounds each----	37
Two reels and frames, 55 pounds each with cable----	110
Five auger bits in canvas roll-----	15

The cost of each complete unit is approximately \$550.

SUGGESTED METHODS FOR LOCATING BORED HOLES IN SNAG-CUTTING OPERATIONS

Figure P-7 illustrates some of the possible combinations of bore holes than can be deto-

nated by the ordinary cap-and-fuse method, using only one cap. Any combination of bore holes can be used with full assurance that the entire charge will detonate providing there are no breaks in the powder train. If a break is desirable or necessary, make the connection with a piece of cordeau as shown in 12, figure P-7.

Forty-percent straight dynamite has proved the most effective powder to use. Roughly, a stick of powder 1 inch in diameter and 8 inches long will give a clean shear of about 64 square inches or 4 inches on each side of the hole. However, owing to the fanning out of bore holes from a common center this cannot be used as a formula in arriving at amount of powder to use for snags of a given diameter. Each snag, owing to difference in shape and structure of wood, is a problem in itself.

Dynamite sticks 1 inch in diameter have been found to be the most economical and efficient and give the cleanest shear when loaded in 1 $\frac{1}{8}$ -inch holes. As the 1-inch stick fits snugly in the 1 $\frac{1}{8}$ -inch bore hole, no slitting of cartridges is necessary, thus saving time in loading. Dynamite 1 inch in diameter is not stock size for the west coast but manufacturers are equipped to turn out this size on short notice and have no objection to doing so.

The shearing effect of a charge of dynamite loaded in a bore hole of a given diameter does not increase in proportion to increase in diameter of bore hole. More pressure is exerted, however, but this pressure follows the line of least resistance which, after a certain amount of shear has taken place, is parallel to the grain of the wood—best illustrated by the brooming effect on stumps. A broom-top stump is a good indication of overloading in spots and improperly spaced holes.

Nothing is gained by the concentration of a large amount of powder either in a single large

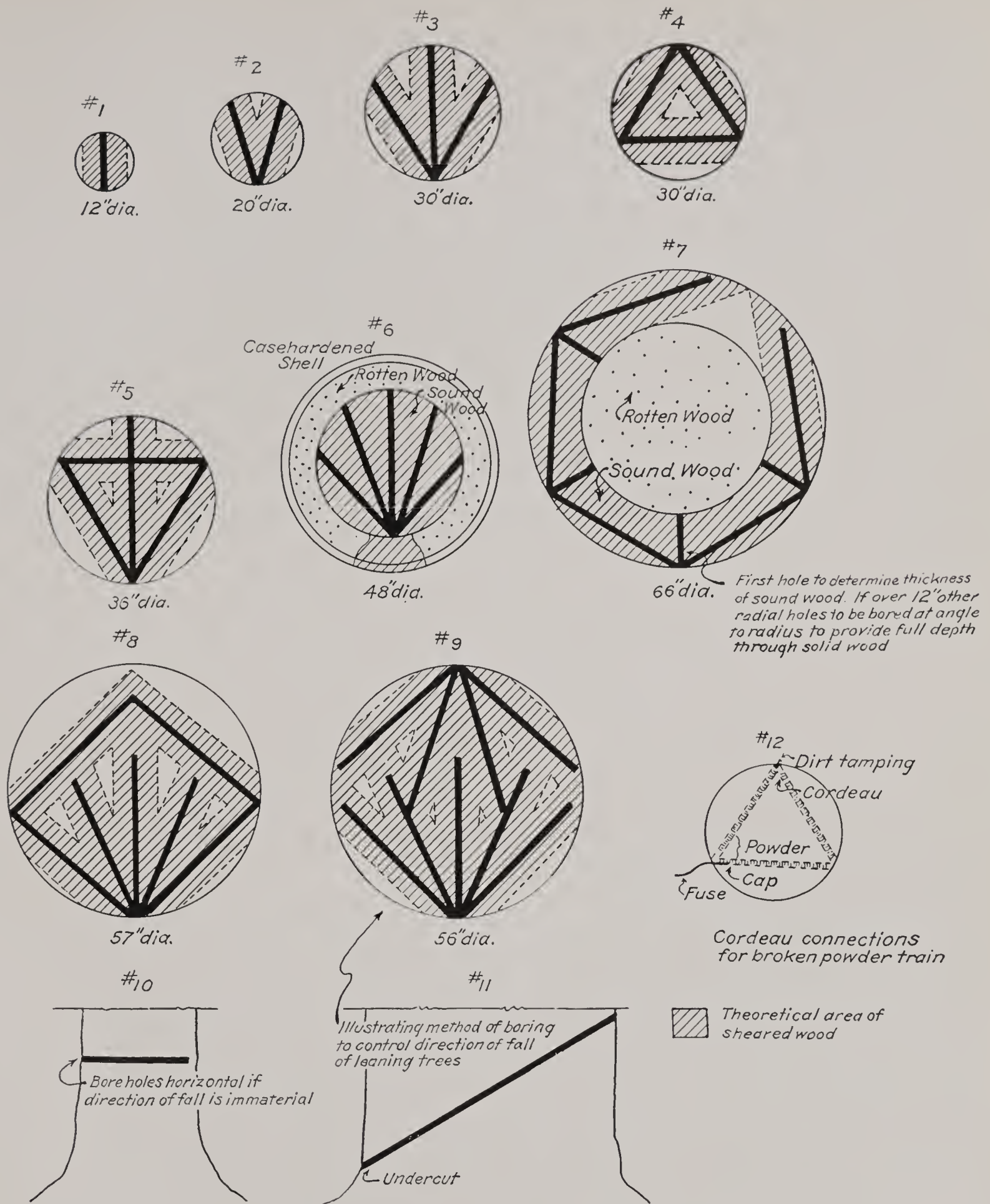


FIGURE P-7.—Suggested methods of locating bored holes in snag-cutting operations.

hole or a number of small holes closely spaced unless it is desirable to apply extra force as is necessary in felling snags against their lean. Sufficient powder must then be concentrated as near the center as possible to lift and throw the butt of the snag past its center of gravity (fig. P-7, 9, 11). Another case of deliberate

overloading is illustrated in 6 where it is necessary to break through a layer of rotten wood and casehardened shell.

Comparatively small diameter holes, not to exceed $1\frac{1}{8}$ inches, properly spaced, are the most efficient and economical, giving the greatest amount of shear for the amount of powder

used. This was determined by rather exhaustive tests conducted in cooperation with representatives of a powder company.

When using a combination of holes, one or more of which are connected in the center of snag, as in figure P-7, 9, to insure an unbroken powder train, it is good practice to insert a piece of cordeau, being sure that it extends some distance into the connection bore hole. If this precaution is not taken a few auger chips might break the powder train and result in a partial misfire. When using cordeau to connect the powder around a sharp angle, as illustrated in Figure P-7, 4, 5, 7 or 8, bend the cordeau carefully (it breaks easily if bend is too short) and let it extend into each charge of powder about 6 inches; tamping can then be inserted (fig. P-7, 12).

The following files should be available to sharpen augers: 4-inch, flat, smooth; 4½-inch, triangular, smooth; 8-inch, round, smooth.

In operating the drill outfits it is essential to always stop the motor before using the reverse switch. If the motor is not stopped, it may burn out.

Snag-Felling Machine. (R1-X.)

The Region 1 snag-pusher attachment for trail builders was developed after several years' experience using heavy bumpers with teeth extended on the front of tractors of Caterpillar 60 and Allis-Chalmers 75 types; and from this, the idea of an extended bumper attachment for a lighter tractor for use in connection with fire-control work originated (fig. P-8).

The snag pusher consists of two 8-inch channels weighing 11.5 pounds per foot and 20 feet long fastened to the dead axle shaft of the

tractor by a special bracket easily detached by taking out six bolts on each side. These channels, which are braced laterally and reinforced at the bends, fit close to the sides of the tractor and taper from 7 feet 6 inches at the back end to 2 feet 4 inches at the front end which extends 10 feet ahead of the moldboard. The front end of the ram is fastened together by a U-shaped reinforced bar on which scallops or teeth with sharp edges are cut. These teeth keep the ram from sliding up the side of the tree. At the point where the front end of the lift arms of the trail builder is fastened onto the side channels by the forward-lift link assembly an adjusting bracket has been installed. This is pin connected to the arms of the frame of the trail builder so the ram can be raised or lowered as desired. In addition to this adjustment the ram is also adjusted for height by the raising and lowering of the side channels and moldboard. The extreme lift of the ram or bumper is 15 feet above the ground, giving very good leverage at this point against trees or snags to be pushed over.

Advantages.—A machine mounted on a trail builder has the following advantages: In building fire line close to the fire edge, the operator cannot pick the ground he wishes to travel on. With the trail builder, he can cut out a trail that is possible to get the tractor over and build a fire line and a trail for the tractor at the same time on steep sidehill for short distances. On ground where the tractor can be manipulated without making a trail, the machine will, of course, move ahead faster, pushing logs or brush piles out of the way with the moldboard, and pushing down with the bumper, trees and snags on either side of the fire line, or burning



FIGURE P-8.—Snag-felling machine.

snags out in the burned area. No trouble has been experienced pushing over trees and snags up to 24 inches. Above this size, it depends on how hard the ground is and the root structure under the trees. Snags generally can be tipped over more easily than green trees al-

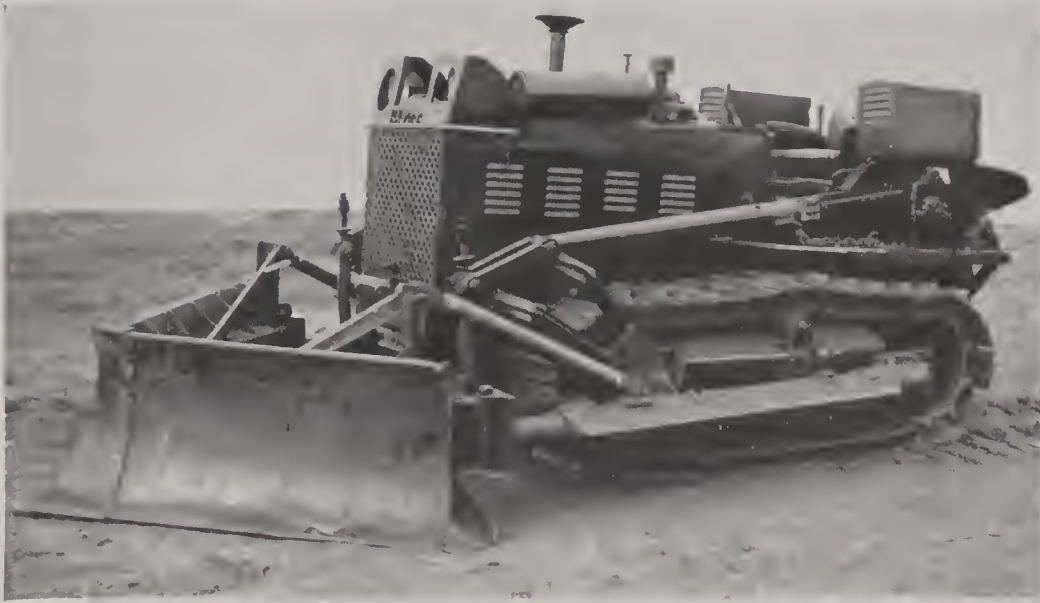


FIGURE P-9.—Brush-buster machine.

though they are much more likely to break off. In Region 1, all tree species up to 30 inches have been tipped over except larch which has a very deep taproot. On one test where actual count was kept, eight snags averaging 20 to 30 inches were tipped over in 30 minutes and 500 feet of line was made through an old, logged-off area on level ground. On another test, 13 snags were tipped out, 7 from 14 to 18 inches, 5 averaging 28 inches, and 1 32-inch Douglas fir; also, 15 chains of line were made through an old logged-off area in 1 hour 30 minutes. A number of fire foremen and forest officers were at these demonstrations and it was agreed that the trail builder did as much work as a crew of 30 to 50 men.

Disadvantages.—A 55 trail builder and tree pusher is a heavy and expensive piece of equipment. The only fires on which it can be used to advantage are those close to roads and on fairly level ground. It takes a skilled operator to handle the machine and not get hurt himself or damage the machine, because a quick jerk may bring down the top of a burned or rotten snag. There are a few trained operators who can handle these tree and snag pushers successfully, but many are afraid to operate the machines. This equipment is very satisfactory in its place, but is too specialized for wide use. It is well adapted for such work as construction of fire-breaks and hazard-reduction work in old burns and snag-infested areas. A roof has been built

over the tractor to protect the operator and machine, but the experienced operators object to using it because it obstructs their vision.

It is not believed advisable to consider this attachment for a larger tractor for general use since the heavier machine would be slower and harder to maneuver on steep slopes. On fairly level ground in large timber, however, it would prove a useful piece of equipment.

The cost of the tree-pushing attachment is approximately \$275 and it can be attached to any 1935 Garwood trail builder on a 55 Cletrac in 2½ hours by two men.

Brush-Buster Machine. (R6-X.)

A V-shaped machine designed for attachment to the front end of a trail builder frame on a tractor of 35 or 55 horsepower is the brush buster (fig. P-9). The model illustrated is attached to a mechanical-lift trail builder carried by a Cletrac tractor. It can be adapted to other makes by changing design of connections slightly. The purpose of the machine is to clear brush, small trees, logs, and debris in fire-line construction. It is not intended for plowing trench, but under favorable conditions a second trip over the line accomplishes fairly complete clearing to mineral soil. It is desirable to use this machine for clearing and to follow with a tractor or horse-drawn plow. Weight of the 35 size is about 750

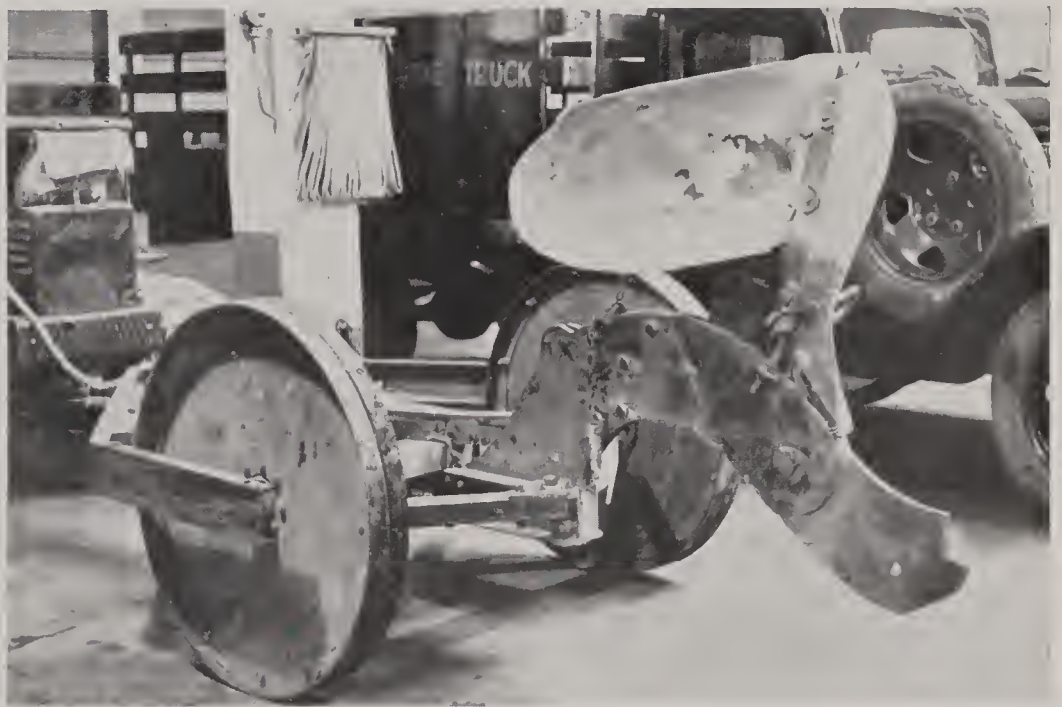


FIGURE P-10.—Region 6 fire-line trencher.

pounds; of 55 size about 900 pounds; approximate cost \$275 to \$300 according to size.

Fire-Line Trencher. (R6-X.)

Region 6 has designed a heavy-duty two-wheeled middlebuster type of tractor-drawn fire-line plow (fig. P-10). The plow is so

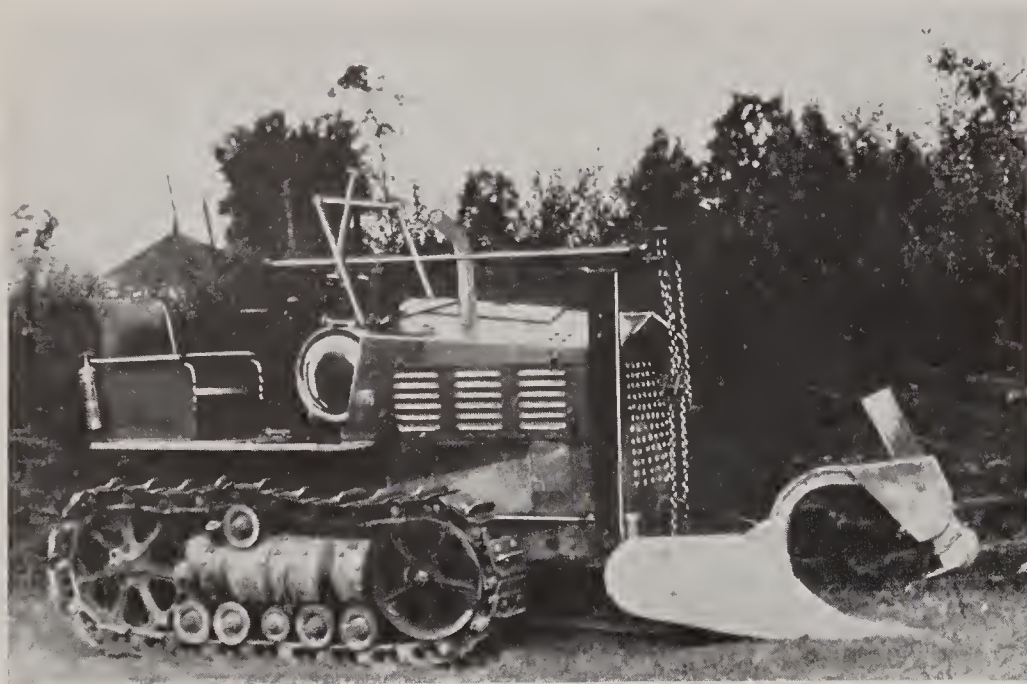


FIGURE P-11.—Fire-line plow developed by Arkansas State Forest Service, Little Rock, Ark.

designed as to withstand rough going of any sort and will stay right side up anywhere that a tractor can go. This particular plow is designed primarily for use with the crawler-type tractor and works quite satisfactorily when pulled by the 35 size. It can be handled by a smaller size tractor if the going is not too rough or the soil too rocky or full of stumps. It is unnecessary to clear ahead of this trencher any more than that which is required to get the tractor through.

Detailed specifications may be obtained from the regional forester, Portland, Oreg.

Lightweight, Crawler Tractor Plow. (Arkansas State Forester, Little Rock, Ark.—X.)

The Arkansas State Forest Service has designed a substantial mechanical-lift plow which can be attached to the front of a 20 or 30 size crawler-type tractor (fig. P-11). The plow is supported by a swinging beam which projects from beneath the tractor and a framework built over the front of the tractor including a worm gear and take-up shaft from which a cable or chain is extended to the plow for raising and lowering the same. The plow may be raised and lowered by the operator while sitting in the driver's seat. The plow has a forward projecting beam to the front end of which is attached an adjustable depth gage or shoe so that the plow may be set for constructing a trench of any depth desired. The plow itself is of the middlebuster type.

You are referred to the Arkansas State forester for further detailed information or for specifications.

Rolling - Disk, Fire - Line Plow.
(Florida State Forester, Tallahassee, Fla.—X.)

The Florida State Forest Service uses a rolling-disk tractor plow for fire-line construction work (figs. P-12, P-13). The plow is provided with a small center buster and two rolling disks upon each side and immediately behind the center buster. The plow is built for exceptionally heavy-duty work upon fairly level ground. It plows a fire line about 6 feet in width and down to 8 inches in depth. It is unnecessary to clear brush, rotten logs, or rotten stumps before using this plow. Heavier stumps, solid logs, trees, etc., must, of course, be cleared



FIGURE P-12.—Florida rolling-disk fire-line plow.

away beforehand. The plow is equipped with power lifts which are controlled from the tractor driver's seat.



FIGURE P-13.—Florida rolling-disk fire-line plow in action.

The entire weight of the plow is carried on its two wheels. The approximate weight of the plow is 3,600 pounds, and while

it can be operated with a 35 tractor (crawler type), the 50 size tractor is more satisfactory.

This plow, as described and illustrated, can be purchased for approximately \$600 to \$700. For further detailed information refer to the Florida State forester.

Tractor-Drawn Walking Plow. (Michigan Forest Fire Experiment Station, Roscommon, Mich.—X.)

The Michigan State Forest Service has developed at its Roscommon Experiment Station, a heavy-duty type of walking plow for use with a small tractor in fire-line construc-

tion work (fig. P-14). The plow weighs approximately 600 pounds and is constructed substantially like the conventional steel-beam type of horse-drawn walking plow. The furrow cut by the plow, together with the rolled sod, leaves a fire line approximately 40 inches in width. The plow is adaptable for use with either a wheel-or crawler-type tractor of 20 to 30 horsepower wherever a tool of this nature is suitable for fire-line construction.

Detailed specifications or further information regarding this particular item of equipment can be obtained from the Michigan Forest Fire Experiment Station, Roscommon, Mich.



FIGURE P-14.—Tractor-drawn plow developed by Michigan Forest Fire Experiment Station, Roscommon, Mich.

SECTION Q
TRANSPORTATION EQUIPMENT, ANIMAL PACKING

SECTION Q

TRANSPORTATION EQUIPMENT, ANIMAL PACKING

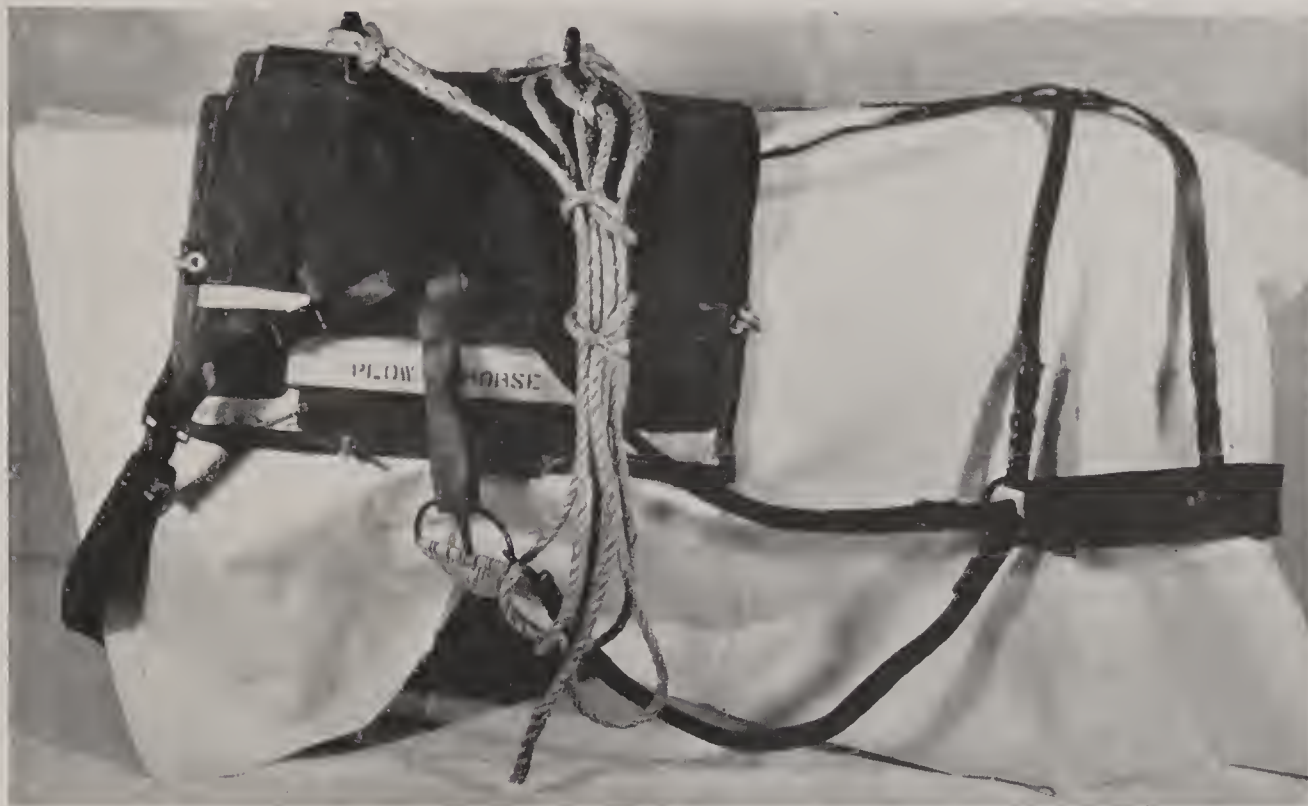


FIGURE Q-1.—Complete Decker packsaddle with sling ropes.

Decker Packsaddle. (Index No. MSF-307. R1-X.)

The Decker-type packsaddle was developed in Region 1 quite a number of years ago by outside agencies in the business of commercial packing (figs. Q-1, Q-2). The Decker-type saddle is especially adapted by heavy-duty packing. It consists of a tree which is made

from cottonwood side bars, held in place by two steel bars or forks instead of the usual hardwood crosspieces. The tree is then outfitted with a complete aparejo, pad, breeching, and breast straps. The saddle requires but a single cinch.

This particular type of saddle is used almost universally throughout Region 1 and in some



FIGURE Q-2.—Decker packsaddle tree, illustrating steel cross bars and rigging strap attachments.

parts of Region 4. Wherever it has been used to any great extent by packers, it has been proclaimed superior to the old style cross-tree or sawbuck type of packsaddle. In a few instances where the Decker has first been tried out, objections have been voiced. Upon investigation of these cases it has been found that the saddletrees were not fitted to the animals upon which the saddles were used. This is one of the particularly outstanding features of the Decker saddle, in that the tree can be shaped to fit individual horses or mules simply by heating and bending the steel forks.

The specification covering this item provides for a complete saddle, including Decker tree, aparejo, pad, breeching, breast strap, latigo straps, and cinch. Since Region 1 uses the Decker packsaddle only throughout the region and always has a surplus stock on hand, it is recommended that Forest Service units desiring to purchase this particular type of equipment do so through the Region 1 procurement division, in order that satisfactory saddles may be secured.

Cross-Tree Packsaddle. (Index No. MSF-306.)

The cross-tree type of packsaddle is the old conventional style of packsaddle familiarly



FIGURE Q-3.—Cross-tree packsaddle.

known as the sawbuck type. It consists of cottonwood side bars or backpieces, fastened together with hardwood cross bars. The saddle is equipped with breeching, breast strap, and double-rig cinches and latigoes. It does not provide an aparejo pad, which necessitates using more padding beneath the saddle to protect the animal from the pack load. The type of tree employed in this particular saddle is what is known as the Ole Hagen pattern.

The specification covering this particular equipment item will secure a packsaddle as described above and as illustrated in figure Q-3, except for the extended hardwood cross bars which have been modified so that they do not extend below the cottonwood backpiece of the tree.

Packsaddle Cinch. (Index No. MSF-98.)

The specification covering this item provides a mohair cinch approximately 25 inches in length and constructed for heavy-duty use. This particular type of cinch is quite universally used for rigging packsaddles.

Cinch, Lash. (Index No. MSF-97.)

The lash cinch is for use in lashing on the load where a large canvas pack cover is used. It consists of a $6\frac{3}{4}$ by $26\frac{1}{2}$ -inch three-ply heavy duck, cinch band equipped at one end with a dee ring and at the other end with a dee hook, so that a lash rope can be used.

The use of the lash rope and throwing the diamond hitch is rapidly becoming a lost art, especially where the Decker type of packsaddle is used. The more simple and fully as efficient manner of swinging the side packs involves the use of individual sling ropes upon each side of the saddle in which the side packs are swung.

Packsaddle Latigo. (Index No. MSF-228-S.)

Latigo straps of a quality suitable for pack transportation work can be obtained by using the following specification:

Specification.—Latigoes shall be constructed from grade No. 1 latigo leather and shall be constructed to the following dimensions: Length shall be not less than 7 feet 2 inches; width shall be not less than $1\frac{5}{8}$ inches; thickness shall be not less than three-thirty-seconds of an inch.

One end of latigo shall be tapered beginning at a point approximately 1 foot from one end, tapering to a width of seven-sixteenths of an inch at the end. The other end shall not be tapered.

Packsaddle Blanket. (Index No. MSF-47-S.)

A good, serviceable, wool-filled blanket can be obtained at a reasonable cost by using the following standard specification:

Specification.—Wool-filled blanket 66 by 84 inches, in accordance with type 2, table 1, of Federal specification No. DDD-B-421a, as amended. Weight shall be 4 or 5 pounds, as specified.

Packsaddle Pad. (Index No. MSF-260.)

The packsaddle pad is of the quilted type, approximately 30 inches long by 36 inches

wide—18 inches wide on either side of the hinged center of the pad. Each side of the pad is filled with approximately $11\frac{1}{2}$ pounds of pure deer hair, which is evenly distributed with covering stitched quilted pattern. This pad is specially designed for heavy-duty use in connection with pack transportation.

Leather Halter. (Index No. MSF-166.)

A heavy halter, designed primarily for leading pack animals. Made of first-grade harness leather, with $1\frac{3}{4}$ -inch crown piece, cheeks, and chin strap, lined with latigo leather. Face piece, $1\frac{1}{4}$ -inch latigo leather, split at both ends. Draw-type chin strap. Throat latch fastened with harness snap.

Rope Halter. (Index No. MSF-167.)

A substantial halter for light use, where the more expensive leather halter is considered unnecessary. Made of $\frac{1}{2}$ -inch braided white cotton rope, with malleable metal clamps, cadmium finished. Weight approximately 1 pound. Specification gives dimensions for large and medium sizes.

Bag, Packsaddle. (Index No. MSF-31.)

Designed for use with cross-tree saddle, but may be used with Decker saddle by buckling the hanger straps through the cross bars on the saddle. Made of No. 2 medium-texture duck, with straps and ends of harness leather. Size approximately 12 by 25 by 17 inches (fig. Q-4).



FIGURE Q-4.—Canvas packsaddle bag.

Pack Cover, Large Size. (Index No. MSF-106.)

The large-size pack cover is constructed of heavy duck and is 6 by 12 feet in size. Grom-

metals are provided at all four corners and at the center of each side so that the cover may be used for other purposes, such as a camp shelter, etc. This type of cover is for use only

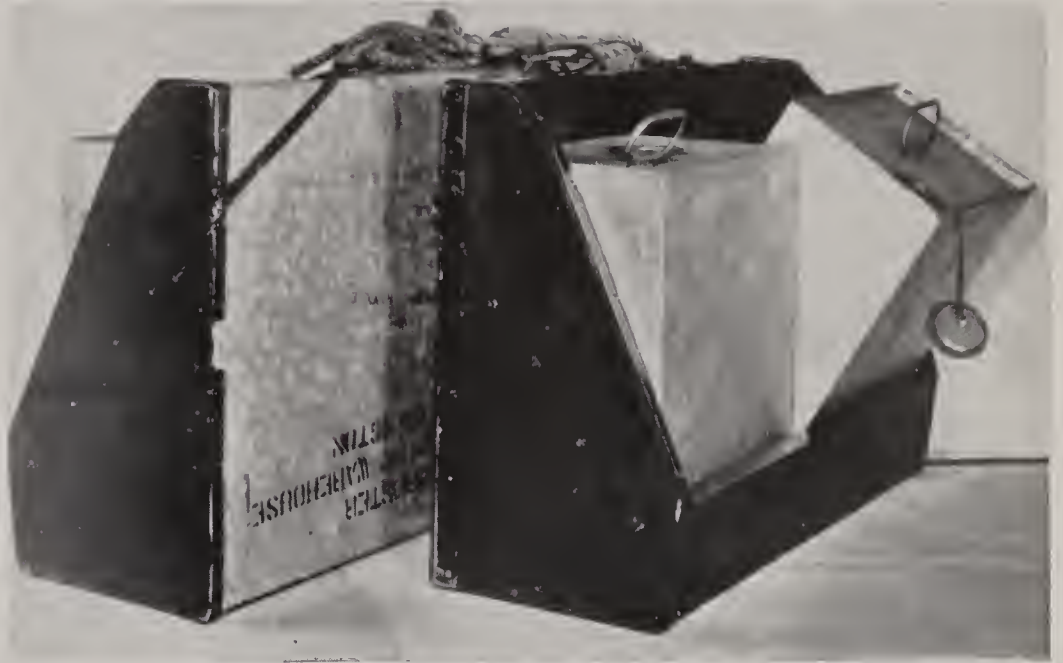


FIGURE Q-5.—Horizontal-type water-can carrier.

where it is desirable to cover the entire animal load after packing. For small pack covers or cargo mantas, refer to the next item.

Cover, Pack Manta. (Index No. MSF-107-S.)

The small size pack cover, or better known as the cargo manta, is for use in cargoeing individual side packs for animal transportation. It can be made from any good grade of heavy duck 72 inches in width without the necessity of any hems or grommets. The following standard specification will obtain canvas suitable for the purpose:

Specification.—Natural finish No. 6 hard-texture gray duck 72 inches in width, in accordance with Federal specification No. CCC-D-771a, as amended, type 1, table 1.

Water-Can Carrier, Horizontal Type. (Index No. MSF-87.)

This type of carrier is especially designed to accommodate two of the standard 5-gallon horse- or truck-transporting water cans (index No. MSF-81). One carrier and two cans, when filled, constitute a side pack for an animal (fig. Q-5).

The carrier is constructed of select $\frac{3}{4}$ -inch pine material at bottom and ends and is provided with a 30-gage galvanized-iron backing so that it can be used for transporting oil without danger of the oil coming in contact with the animal. Two-inch iron rings are provided at the top of the carrier so that it may be hung from the saddletree with either ropes or leather straps. The carrier is so constructed that the cans may be filled in place while packed on an animal, or they may be removed from the carrier without removing the carrier from the animal.



FIGURE Q-6.—Vertical-type water-can carrier.

If further insurance against cans coming out of the carrier is needed for especially rough packing, two pieces of harness-leather strap and buckles can be added without difficulty to buckle over the top of each can.

Water-Can Carrier, Vertical Type. (Index No. MSF-87-1.)

The vertical-type water-can carrier (fig. Q-6) is designed to carry two of the standard horse- or truck-transporting cans (index No. MSF-81), one setting upon top of the other. The only advantage in this type of carrier over the horizontal-type carrier is that it can easily be manufactured by anyone possessing the specification.

It is constructed entirely from $\frac{3}{4}$ -inch common lumber, cement-coated nails, and metal box strapping. A harness-leather strap is used to hold the cans in place in the carrier.

The disadvantages of this type of carrier over the horizontal type are: (1) it is not constructed as sturdily and therefore will not last as long, and (2) it is good only for trans-

porting water since it will not protect the animal from spilled oil when oil is transported.

Horse Goggles. (Index No. 156.)

Designed for use when transporting horses or mules by truck or trailer. The article consists of a canvas hood fitted with transparent eyepieces. It provides an economical means of protecting the animals' eyes from dust and wind, obviating the necessity for specially constructed windbreaks on trucks and trailers. It can be adjusted to fit most animals.

Nose Feed Bag.

The Forest Service has adopted the Army type of nose feed bag for use as standard (fig. Q-7). A large supply of these bags is on hand at the Supply Depot, and Region 1 also has a small stock available; therefore, until Forest Service requisitions have depleted these stocks, a specification will not be prepared for a nose feed bag.

Veterinary Kit. (Refer to sec. G, Medicine kits and first-aid equipment.)



FIGURE Q-7.—United States Army-type nose feed bag.

SECTION R
TRANSPORTATION EQUIPMENT, VEHICULAR

SECTION R

TRANSPORTATION EQUIPMENT, VEHICULAR

The types and designs of trailers used in connection with fire-control work are so many and varied that to enumerate them all in the handbook and to include detailed specifications for each and every one within the master file would be impracticable. Instead, the fire control equipment committee has selected from the

locally available. Therefore, it is felt that with such information as can be afforded in the handbook by descriptive write-ups and illustrations, that agencies or individuals interested in any particular trailer item will be able to gain sufficient knowledge to meet the requirements. If not, they may request further in-

formation from the agencies to which references are made and whose information and specifications in all probability will be more nearly up to date than would be the case if detailed specifications were maintained within the master specification file.

Trailer, 10-Man, Fire-Tool Outfit. (R4-X.)

The 10-man fire-tool outfit trailer is a light-weight, un-sprung, solid-axle type of trailer, carrying a tool box approximately 2 feet 1 inch by 5 feet 7 inches, and 1 foot 11 inches in depth. It is specially designed to accommodate a standard 10-man tool outfit which is disposed within the

trailer. The trailer box has center-opening hinged lids which open up at either side of the box and which may be fastened shut with hinged hasp and staple.

This particular type of trailer is especially suited for maintaining a fire-tool cache which is already loaded and is ready to hook onto with any light car where truck transportation or other means are not readily available. Detailed specification has been prepared for this trailer.

Trailer, 25-Man, Fire-Tool Outfit. (R4-X.)

The 25-man, fire-tool trailer (fig. R-1) is identical in type and manner of construction



FIGURE R 1.—Arrangement of 25-man outfit within trailer.

many types of trailers for which data has been submitted, a few of the more outstanding designs for which descriptions will appear in the handbook and a reference indicating to which Region or other source, requests should be made for further detailed information, or for detailed specifications. In most cases, the Regions or agencies concerned have already prepared detailed specifications for the trailers described.

The principal reason for not including detailed specifications for trailers described within the handbook is that changes are quite frequently necessary, either to meet local conditions, or to utilize such materials as are



FIGURE R 2. Kitchen trailer ready for use as a table.



FIGURE R-3.—Side view of Region 1 one-horse trailer.

feet in size. The trailer is equipped with two jackscrews which hold the trailer bed level and stable when it is in use as a kitchen table. Detailed specification has been prepared for this trailer.

Trailer, One-Horse. (R1-X.)

The Region 1 one-horse trailer is the solid unsprung-axle type of two-wheeled trailer using standard pneumatic tires (figs. R-4, R-5). The framework supporting the floor boards is of 4- by 4-inch material, while the box itself is of $\frac{3}{4}$ -inch common lumber. A carrier is provided on the side of the body for carrying a spare tire. The specification which has been prepared for this particular type of trailer provides a body which can readily be mounted upon any suitable type of running gear that may be avail-

to the 10-man tool trailer, except for box dimensions. The box on this trailer is approximately 3 feet 1 inch by 6 feet 5 inches, and 3 feet 4 inches in depth. Like the 10-man tool trailer, this trailer is especially useful where truck or other sort of transportation facilities are not available and where it is desirable to have a 25-man tool outfit loaded and ready to go at a moment's notice. This trailer is sufficiently light to be handled by the average automobile without difficulty. Detailed specification has been prepared for this trailer.

Fire-Camp Kitchen Trailer. (R5-X.)

The kitchen trailer is a two-wheeled sprung-axle type of trailer of semiheavy-duty construction, suitable only for use behind a truck (fig. R-2). It can, however, be towed by a car provided the road is smooth and no hills of any size are encountered. The trailer box is approximately 3 feet 6 inches by 6 feet by 2 feet 6 inches in depth, and is designed to accommodate a complete fire-camp kitchen outfit, so that the outfit may be stored therein and ready to go at a moment's notice. At the fire camp, the sides and ends of the kitchen trailer may be folded down flat to make up a work table approximately 8 by 10



FIGURE R-4.—Rear-end view of Region 1 trailer.

able. This trailer, when loaded with one horse, is sufficiently light to be handled by either a car or pick-up truck.

Trailer, One- and Two-Horse. (R2-X.)

The Region 2 type of one- and two-horse trailer provides a bed approximately 72 inches in length, 53 inches in width, by 58 inches in



FIGURE R-5.—Rear-end view of Region 2 trailer.

height, inside measurements (fig. R-5). This space will accommodate two average-size saddle or pack animals without difficulty, and yet will permit transporting one animal alone without necessitating roping or the use of a partition. It is of solid-axle unsprung construction, the wheels using standard pneumatic tires.

In using solid-axle type of unsprung trailers, Region 2 has suggested that from 2 to 3



FIGURE R-6.—Front and side view of Region 3 trailer.

inches of sawdust be placed in the bottom of the trailer. This materially assists in absorbing road shock so that there is less strain on the animals' legs while in transit.

The Region 2 trailer is equipped with a sheet-metal overhanging manger. The rear endgate lets down to form a loading walk for the animals to be loaded.

Specification covering this particular type of trailer has been prepared by Region 2.

Trailer, One-Horse. (R3-X.)

Region 3 uses a one-horse trailer which is constructed somewhat differently from the

usual run of trailers, in that the framework of the trailer, box and all, is of light metal. Figure R-6 illustrates the type of trailer referred to and also the manner of construction, as well as shape of the box. The rear endgate lets down to form an approach to the trailer for loading. Specification for this type of trailer has been prepared by Region 3.

Trailer, One-Horse. (R5-X.)

The trailer illustrated in figure R-7 is used to some extent in Region 5. The only outstanding difference in this trailer from others already mentioned is that it is the sprung-axle type and provides a transparent windshield in the front for protecting the animal from the wind when in transit. As far as this latter feature is concerned, the use of horse goggles (index No. MSF-156) described elsewhere in this handbook obviates the necessity of any special type of windshield for the protection of the eyes of animals while being transported. Specification for this particular type of trailer has not yet been prepared, but persons interested may obtain essential detailed information from Region 5.

Trailer, One- and Two-Horse. (R6-X.)

Region 6 has developed what can be classed as a strictly first-class one- and two-horse trailer (fig. R-8, R-9). This trailer is probably the most substantially constructed and best equipped of all the trailers mentioned. It



FIGURE R-7. Region 5 one-horse trailer with windshield.

is of the sprung-axle type and is equipped with standard pneumatic tires and vacuum brakes, as well as tail light, spare-tire carrier, and other essentials. Like the other trailers, the rear endgate lets down to form a loading approach. Detailed specifications have been prepared for this particular type of trailer and may be procured upon request to Region 6.



FIGURE R-8.—Front and side view of Region 6 trailer loaded with two horses.

Trailer, Horse and Plow Outfit. (R4-X.)

Region 4 has designed a trailer for transporting a single horse and a fire-line plow outfit (figs. R-10, R-11). The inside of the horse rack is approximately 35 inches in width and 68 inches in length by 42 inches deep. The inside dimensions of the plow-outfit boxes, one of which is upon either side of the horse stall, are 18 inches by 72 inches by 28 inches deep. The endgate to the horse-stall section of the trailer lets down to form a loading approach.

Trailer, Water Barrel. (R6-X.)

Region 6 has designed a light-weight two-wheel trailer for hauling two 50-gallon water barrels behind a truck, automobile, or light tractor. The trailer is

provided with a tip-up bed so that the barrels can readily be loaded and unloaded when filled with water or oil (figs. R 12, R-13). Detailed specifications covering this particular item of equipment have been prepared and may be procured from Region 6.

Trailer, Pump, and Water Barrel. rel. (Miss. St. F. S.-X.)

The Mississippi State Forest Service has designed a rather unique type of light weight water-barrel trailer which includes a double-action hand pump for utilizing the water under pressure. The trailer is of exceptionally light-weight construction and therefore readily portable by manpower into areas where a car might not be able to go.

The following brief specification indicates the method of construction and the necessary



FIGURE R-9.—Rear and side view of Region 6 trailer loaded with one horse and showing loading approach.

material for making a trailer of the type illustrated.



FIGURE R-10.—Side view of Region 4 horse and plow trailer.



FIGURE R-11.—Rear-end view of Region 4 horse and plow trailer.

Specification.—Method of manufacture: A frame is made of 1½-inch pipe which forms a cradle for the water container—a 55-gallon iron drum; this frame is welded together and mounted on the axle. A drop-center axle is made of 4-inch channel iron with a spindle welded to each end. Standard Ford or Chevrolet spindles, bearings, and wheels are used. The tongue (1½-inch pipe) is welded to the frame and reinforced. A double-acting hand force pump (Denning P-49) is mounted on the

2 outside bearings.

Complete with spindle, hub wheels, and bearings, lock washer and nuts, and hub cap (axle with hub and wheel, less spring).

10 feet 1-inch hose.

25 feet ½-inch garden hose and nozzle.

1 50-gallon drum.

Reducer, 1 inch to ¾ inch.

Reducer, 1¼ inch to 1 inch.

NOTE.—Axles have been made by using 4-inch channel iron and welding to spindles.

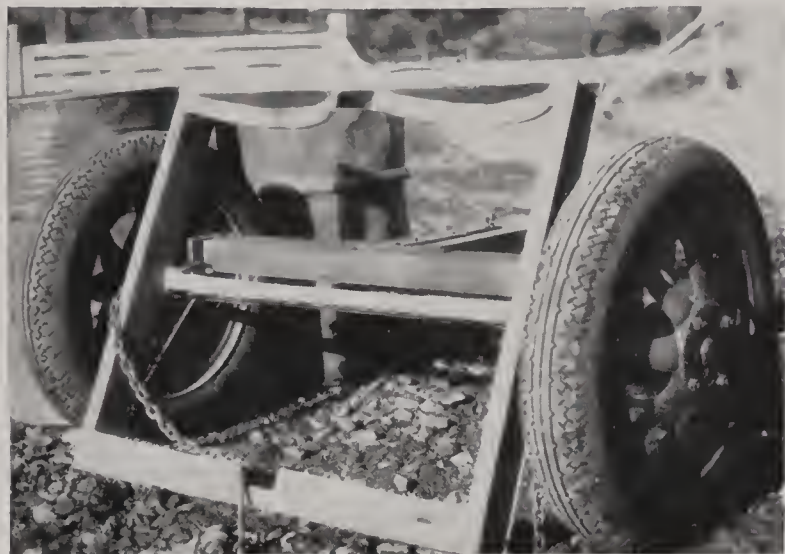


FIGURE R-12.—Region 6 water barrel trailer with bed tilted.

rear of the drum on the frame. It is operated by a hand lever at the rear. Photograph shows entire pump assembly at rear (fig. R-14). This has been changed, as shown, to more evenly distribute the weight.

BILL OF MATERIAL

20 feet iron pipe, 1½-inch.	14 bolts, 7/16 by 3½ inches.
6 feet iron strap, ¼ by 1½ inches.	2 bolts, ½ by 4 inches.
9 foot strap iron, ⅛ by ¾ inch.	2 bolts, 7/16 by 2 inches.
5½ feet strap, ½-inch iron pipe.	4 bolts, 7/16 by 6 inches.
2½ feet strap, ¾ by 1-inch bar iron (this may be lighter.)	1 drop-center axle (pick-up axle 17 or 18-inch wheel).
	2 18-inch wheels (or 17-inch).
	2 spindles.
	2 inside bearings.



FIGURE R-13.—Region 6 water-barrel trailer with bed secured to tongue.

Trailer, Water Barrel, and Back-pack Outfit. (North Carolina State Forest Service—X.)

The North Carolina State Forest Service uses a simple type of trailer to very good advantage in transporting back-pack outfits and an additional supply of water for replenishing the outfits. There is also room for a few additional suppression tools in the trailer which is intended to haul about six back-pack outfits and a 50-gallon drum of water.

As shown in figure R-15 the water barrel is equipped with a pipe extension which protrudes through the rear end of the trailer bed, and where it is equipped with a faucet so that back-pack outfits may be readily filled.



FIGURE R-14.—Mississippi State Forest Service barrel and pump trailer.



FIGURE R-15.—North Carolina State Forest Service back-pack outfit and supply-barrel trailer.

The following brief dimensions will serve as a rough guide for constructing a trailer similar to the one described and illustrated:

Dimensions.—Two - inch angle-iron frame 6 feet long, 48 inches wide, with lumber body 6 feet $11\frac{1}{2}$ inches long, $49\frac{1}{2}$ inches wide with 1- by 8-inch floor and hardwood cross members all bolted to frame. Full height body $16\frac{1}{2}$ inches made of $7\frac{1}{2}$ -inch dressed baseboard and $3\frac{3}{4}$ -inch top board with 2- by 4-inch uprights $17\frac{3}{4}$ inches long bolted to frame.

Three spaces built in alongside for tanks $9\frac{1}{2}$ inches wide, 24 inches long. Box in front, $22\frac{3}{4}$ inches long. A 55-gallon oil drum for water with funnel welded in 8-inch opening. Barrel anchored by strap iron on threaded bolt ends bolted through bottom. Barrel rests on 4 by 4's cut to fit the barrel. Barrel is $17\frac{3}{4}$ inches from rear with $2\frac{1}{2}$ -inch pipe extending through rear end with molasses gate



FIGURE R-17.—Region 3 pressure-tank trailer.

cut-out. Axle of I-beam with spindles welded on. All metal joints electric welded.

Trailer, Water Tank. (R3-X.)

The water-tank trailer illustrated in figure R-16 will furnish handbook readers with some possible information regarding construction of tank trailers. In constructing trailers for the specific purpose of transporting water and where a steel tank is to be used, the fire-control equipment committee recommends that in lieu of round tank as shown in the accompanying illustration, that the standard galvanized-iron tank, index No. 347, as described elsewhere in this handbook, be used. Most of the construction details and the type of material used are



FIGURE R-16.—Region 3 type of water-tank trailer.

shown within the illustration; therefore, there is little need of further discussion of this particular type of equipment.

Trailer, Pressure Water Tank. (R3-X.)

As illustrated in figure R-17, the Region 3 pressure-tank type of water trailer is made of two standard hot-water tanks which are coupled together and provided with a common outlet. The tanks are also equipped with a standard pressure gage. The purpose of a trailer of this nature is to provide a means of conveying water to the location where it is to be used and then having sufficient pressure to permit use of the water in an efficient manner. The pressure range of the standard hot-water tank is from 85 to 100 pounds. This permits filling the tanks under sufficient pressure to permit using the water through a short length of hose and with sufficient force to be practicable in fire-suppression work.

The Region 3 pressure-tank arrangement can be constructed into any suitable type of flat-bed trailer of sufficient length and width to

accommodate the two tanks while lying side by side.

Trailer, Semi, 8-Ton Capacity. (R6-X.)

Region 6 has designed a special stock rack for use on the Region's standard semitrailer.

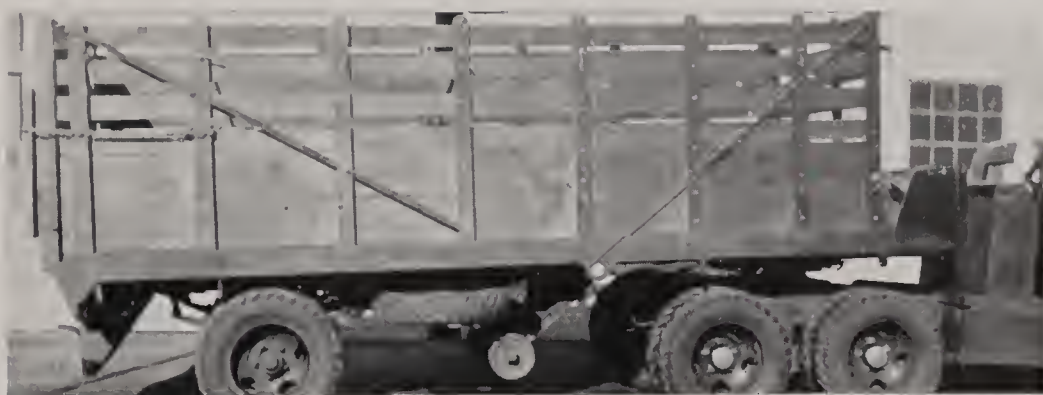


FIGURE R-18.—Side view of Region 6 semitrailer and special stock rack.

used in connection with trucks (figs. R-18, R-19). The rack will accommodate a full string of pack stock, including eight pack animals and saddle horse. The following brief description indicates the manner, method, and material used in the construction of the rack:

Description.—The rack is constructed of oak uprights 2 by 4 inches in size fitted into the existing truck bed. The horizontal members of 1 by 6 inches and 1 by 8 inches, vertical-

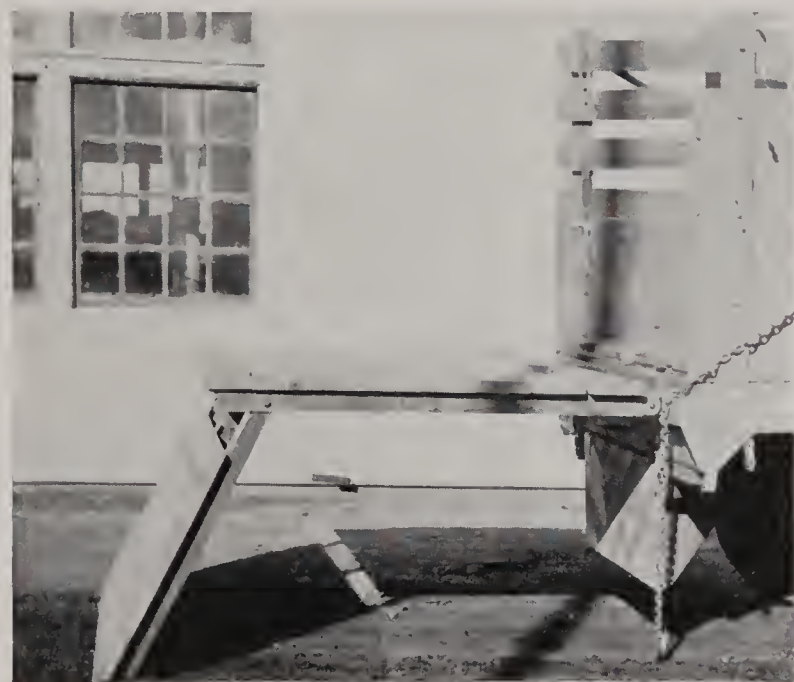


FIGURE R-19.—Showing construction detail of Region 6 special stock-rack endgate.

grain Douglas fir. Machine bolts $\frac{5}{16}$ by 3 inches with $\frac{3}{4}$ -inch washers are used throughout. As the rack is 14 feet 8 inches long by 6 feet 2 inches wide, the sides are constructed in two parts. Therefore, two 2- by 6-inch planks running the full length of the rack; i. e., 15 feet, are bolted in place with machine bolts and wing nuts after the sides are on. The purpose of this is twofold; to strengthen the side of the rack where the two parts are joined together, and to form a solid wall to prevent

animals from getting their feet through the sides of the rack.

A hinged endgate is provided which, as it is let down, unfolds and is long enough to enable animals to be taken in or out of the truck when on level ground and without an unloading platform. Two chains with jack fasteners are used across the center of each section, and one chain with lock link is used across the rear of the rack.

Trailer, Heavy-Duty Plow and Tractor. (R9-X.)

This is a dual-tired heavy-duty two-wheel trailer of the sprung-axle type having a flat bed with let-down end pieces at both front and rear which form loading ramps so that a tractor may be run from the ground to the trailer and from the trailer across to a truck. The trailer is intended for use with a $1\frac{1}{2}$ -ton, or larger, truck. Figure R-20 illustrates the method of loading the trailer and truck. After loading, both end ramps fold up and hold in place whatever machinery is on the trailer.

Trailer, 8-Ton, Tilting-Bed. (R9-X.)

This particular piece of equipment is designed for exceptionally heavy duty behind a heavy truck or tractor (fig. R-21). It is constructed with an exceptionally heavy steel framework mounted on four heavy-duty pneumatic-tired wheels. The bed of the tractor tilts backward to permit driving a tractor di-



FIGURE R-20.—Region 9 plow and tractor trailer.

rectly onto the trailer from the ground. Further detailed information regarding this piece of equipment or detailed specifications, should be requested from Region 9.

Trailer, 5-Ton, Tilting-Bed. (Wis. Cons. Dept.—X.)

The 5-ton tilting-bed trailer (fig. R-22) is similar in design and construction to the 8-ton tilting-bed trailer described, except that it is smaller in capacity and has only two wheels instead of four. This particular piece of



FIGURE R-21.—Region 9, 8-ton tilting-bed trailer.

equipment was designed and is used by the Wisconsin Conservation Department. Further detailed information or specifications should be requested from that department.

Carrier for Back-pack Water Can. (Index No. MSF-92.)

The back-pack water-can carrier is designed for carrying the standard, back-pack can (index No. MSF-79) together with hand pump in a safe manner on either the running board of a car or attached to the side of a car or truck body. If intended for use on the running board of a car, only item 1 of the specification need be used, but if intended for use on the side of a car or truck, then item 2, which is a supporting frame upon which item 1 is secured, must also be used. Item 1, which is the main carrier, is a rubber-cushioned cradle constructed from angle iron and shaped to accommodate the standard back-pack water can. The can is strapped securely in place by a web strap supported at one end by a steel spring and fastened at the other end with a self-locking steel-finger lock.

Both item 1 and 2 of the carrier are included in the specification; therefore, when requesting

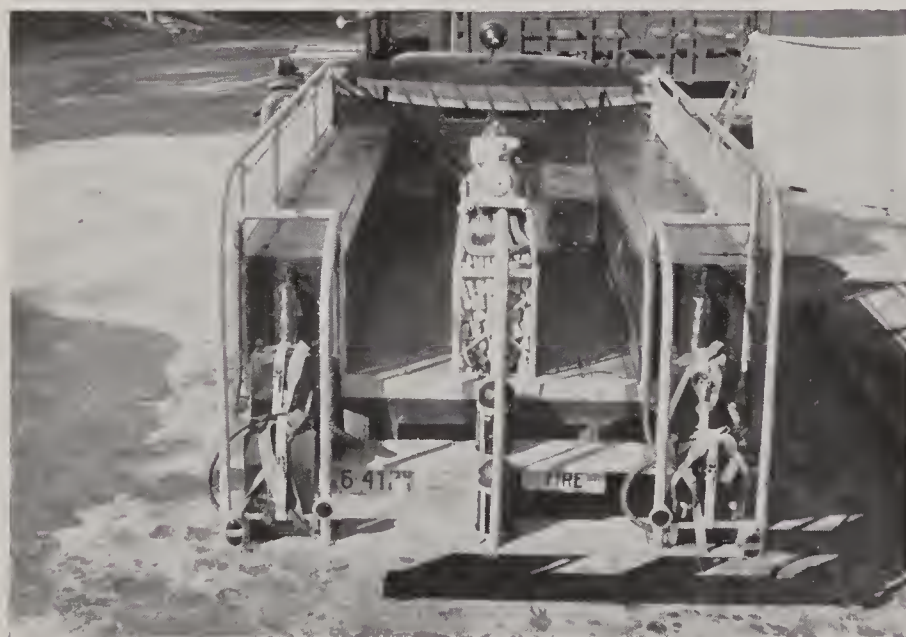


FIGURE R-23.—Rear-end view of Region 5 suppression-squad truck.

these items to be made up, the manufacturer should be notified as to whether or not one or both items are desired. Refer to fig. M-9 or M-10 for view of carrier mounted on running board.

Fire-Truck Loading Ladder. (Refer to sec. M, Power-pump equipment.)

Suppression-Squad Truck. (R5-X.)

Region 5 had designed a special type of body for mounting on a $1\frac{1}{2}$ -ton truck chassis for transporting suppression crew, suppression tools, portable power pumps, a fire hose, and back-pack water outfits (figs. R-23, R-24). The truck bed is arranged so that longitudinal



FIGURE R-22.—Wisconsin Conservation Department 5-ton tilting-bed trailer.

seats on the sides of the truck bed hold the necessary suppression tools as well as provide seating room for the crew. In the center of the truck is a special-built rack for carrying the fire hose and portable power pumper. Handrails and steps are provided at the rear for mounting the truck. Also, the back-pack water outfits are mounted in brackets on the rear steps at both sides of the truck.

This particular design of truck body is quite useful where there are fire-control activities sufficient to warrant the use of a stand-by truck for suppression duty only. The truck bed or body can, of course, be constructed in a detachable manner so that during the off season it can be removed and the truck used for other lines of work. The particular type of body described will accommodate a crew of 15 to 20 men and equipment.



FIGURE R-24.—Side view of Region 5 suppression-squad truck.

Rack, Stock Truck, Demountable. (Index No. 278.)

The demountable stock-truck rack is designed to fit the average $1\frac{1}{2}$ -ton long-wheelbase truck equipped with stake body. It is constructed of 1- by 4- and 1- by 6-inch material throughout. It is simple in design, and can readily be constructed by anyone equipped with the specification, proper tools, and material required.

The particular type of rack designed is quite similar to the one illustrated herein insofar as material is concerned, but is especially designed to be readily demountable by one man if neces-

sary (fig. R-25). Also, one man can very easily assemble the rack on the average $1\frac{1}{2}$ -ton truck when necessity requires. The rack is put together with $\frac{3}{8}$ -inch bolts and is attached to the regular stake body by means of bolts having wing nuts to facilitate mounting and demounting. It is necessary only to bore 20 holes in the stake body to accommodate the bolts which hold the demountable rack in place.

This rack is suitable for hauling any number of head of stock up to the capacity of the truck upon which it is mounted. The specification can be modified quite easily so that the rack is adaptable to any particular type of stake-body truck.

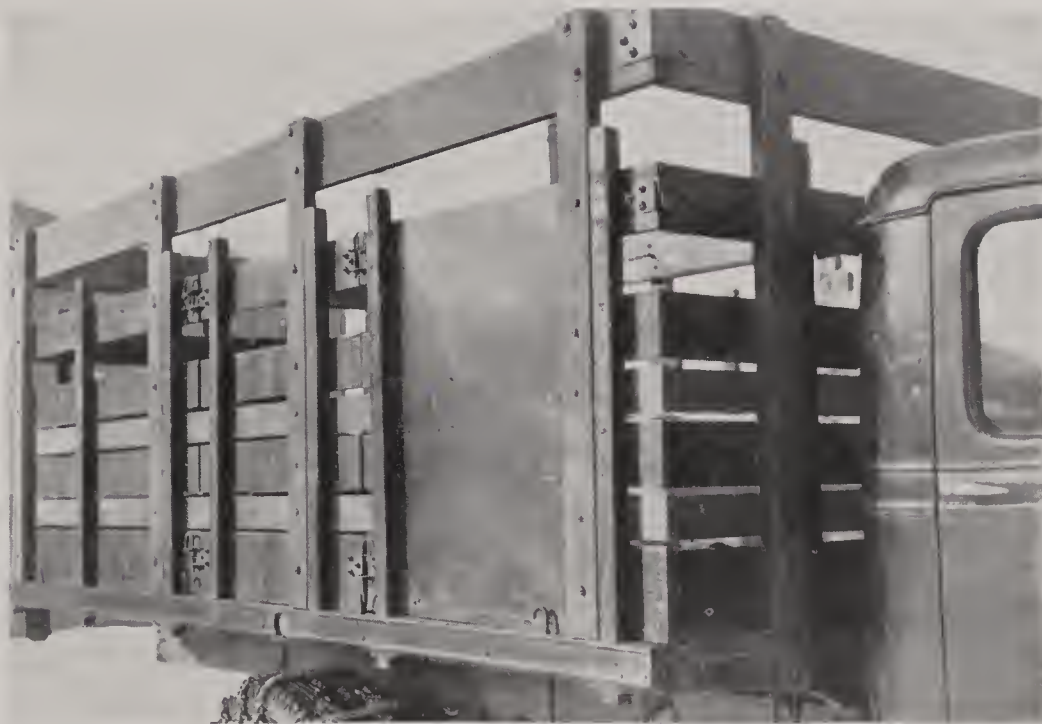


FIGURE R-25.—Demountable stock-truck rack.

SECTION S
MISCELLANEOUS EQUIPMENT

SECTION S

MISCELLANEOUS EQUIPMENT

Badge, Forest Guard. (Index No. MSF-26-1. SDO-P.)

This particular item is the shield-shaped forest-guard badge now in use. The badge is bright nickel finish with the pine tree, Forest Guard, U. S. F. S. and Department of Agriculture appearing upon the face of it.

Badge, Fire Overhead. (Index No. MSF-26-2. SDO-P.)

In order to provide a fire overhead badge for those Regions or units which prefer to use it, a standard badge has been designed. This item will be stocked by the Supply Depot and will be available upon requisition to any of the Forest Service units. The badge is circular in shape, plain nickel finish, with inscription "U. S. D. A.," "Fire Overhead," and "Forest Service" appearing thereon. By using this wording the badge may then be used for any purpose in connection with fire-suppression work, whereas, if specific wording such as "Fire Boss," "Foreman," "Straw Boss," etc., were used the badge would not be as flexible in use.

Concrete Fire-Tool Cache Box. (Index No. 61-1.)

This specification provides a concrete tool box suitable for holding a fire-tool outfit up to as large as 20-man size. The bottom, sides, and half of the roof are made of concrete, the other half of the roof is in the form of a wooden lid covered with 22-gage galvanized iron. The specification shows in detail the manner of construction of both the concrete box and suitable tool racks for the interior. This particular item is especially adaptable for locations where it is desirable to leave fire tools along side roads, trails, or at protection camps where they must be left outside of buildings. This particular box was designed by the Texas State Forest Service.

Metal Fire-Tool Cache Box, No. 1. (Index No. 61-2.)

This box provides room for a fire-tool outfit up to 12- or 15-man size. It is constructed of galvanized iron and is thoroughly weather proof. It is sufficiently light in weight to permit transporting in a truck without difficulty. Figure S-1 provides further description of the item.



FIGURE S-1. Metal fire-tool cache box.



FIGURE S-2.—Ranch fire-tool cache box.

Ranch Fire-Tool Cache Box, No. 1. (Index No. 61-3.)

This box can be manufactured from common grade of lumber 1 inch thick and with the specification available it may be constructed by almost anyone. It provides sufficient room for a three- to five-man fire-tool outfit. Figure S-2 illustrates the box and shows how it may be fastened to the side of a building.



FIGURE S-3.—Twenty-five-man cache box permanently mounted.

Ranch Fire-Tool Cache Box, No. 2. (Index No. 61-4.)

This fire-tool cache box is similar in size, material, and ease of construction to box described under index No. 61-3, but does not have the flared top, the sides being perpendicular from top to bottom. It can very easily be constructed by anyone who may be furnished with the specification. This box may be transported with ease after construction.

Metal Fire-Tool Cache Box, No. 2. (Index No. 61-5.)

This item is constructed more on the order of a regular box than the cache box described under index No. 61-2. It is also of a smaller capacity, being suitable for not over an 8- or 10-man tool cache. This particular box is constructed of galvanized iron and is 2 feet 6 inches wide, 2 feet 3 inches deep, and 6 feet high, with a door across the width of one side and 4 feet 6 inches in height. The specification provides for tool racks on the interior of the box. The shipping weight is approximately 165 pounds.

Fire-Tool Cache Box, Frame. (Index No. 61-6.)

This box is of the large, flat type with sloping roof, which also constitutes the lid of the box. The base dimensions of the box are 3 by 6 feet, and the height of the box is 3 feet at the back side and 2 feet at the front side. It may be constructed of any No. 1 common lumber, $\frac{3}{4}$ -inch tongue-and-groove material preferred. It is suited for caching fire-tool outfits up to 25-man size. Various modifications

of this specification can be made to accommodate local requirements. Figure S-3 illustrates this type of box set up on a permanent concrete base. Figure S-4 illustrates a rather unique method of modifying the box from a permanent location purpose into a transportable fire-tool cache box by simply adding a strong handle piece the full length of each side and mounting the box upon rollers the proper height for rolling it into a truck.

Fire-Tool Cache, Portable, 100-Man Size. (R5-X.)

Region 5 has designed a very efficient type of portable 100-man fire-tool cache for use in connection with C. C. C. camps and other large crews. It is comprised of a small frame structure resembling a single-room shanty-roof cabin approximately 8 by 12 feet, by 8 feet in height. The dimension timbers used are all 2 by 4 or smaller, and the sheeting material is No. 1 common lumber.

The cache is so designed that there are five handles which project out from the base of the structure along each side. After removing the tools from the cache a small crew of men can very easily load the cache upon a truck for transportation to any desired location. The



FIGURE S-4.—Twenty-five-man cache box mounted for loading.

roof consists of $\frac{3}{4}$ -inch sheeting covered with outside roofing or tar paper.

A specification has not been prepared for this particular item since it is believed that it may quite easily be constructed by anyone possessing some carpentry skill by simply referring to figures S-5, S-6, S-7, and S-8. The

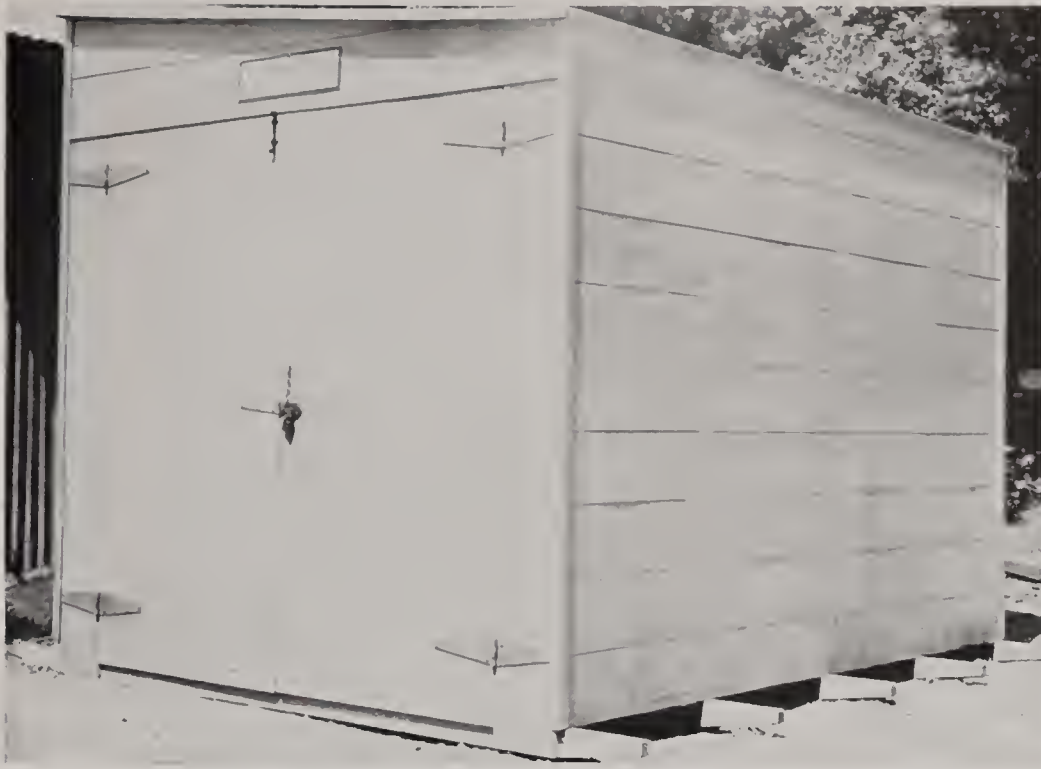


FIGURE S-5.—Exterior of 100-man portable fire-tool cache.

cache, of course, may be constructed from any suitable material which may be available. Also the size of the cache may easily be modified to accommodate local requirements.

The interior of the cache is provided with suitable shelves, brackets, racks, etc., for holding such equipment as may be stored therein. The accompanying illustrations portray clearly the type of shelves, shovel and ax racks or brackets, etc., used by the California Region.

A rather unique type of sheath or shield is shown in connection with the ax racks. This shield consists of a piece of sheet metal shaped to slide over a rack full of ax heads, thus covering the bits so that persons working next to them cannot come in contact with them and be injured or cause injury. The shield is provided with a handle at the top for drawing it on and off the racked tools.

FIRE-TOOL TRANSPORTING BOXES

There are innumerable sizes and types of fire-tool boxes used in connection with forest protection work. Some of them are rather unique in construction and design, and serve a very definite purpose. There are many others which are just plain boxes. In order to furnish handbook users with a cross section of ideas with respect to

more or less especially designed boxes, several types are included in the handbook. Brief descriptions, giving rough dimensions, together with an illustration, are contained for the types included. Detailed specifications are not carried in the master specification file, due to the fact that equipment of this type is usually constructed to conform to local requirements and to utilize local materials and facilities available.

Ten-Man Fire-Tool Box.

This particular box is used by Region 6 for containing a complete 10-man fire-tool outfit, including lights, saws, and mess equipment (fig. S-9). It can be constructed from any available $\frac{3}{4}$ -inch lumber; tongue-and-groove material, of course, is better adapted to the purpose. The ends of the box are bound with metal box strapping or light-



FIGURE S-6.—Interior of 100-man portable fire-tool cache.



FIGURE S-7.—Close-up view of method of constructing shovel racks in 100-man fire-tool cache.



FIGURE S-8.—Close-up view of ax rack showing ax-head shield in 100-man fire-tool cache.

weight angle iron. Extra heavy chest handles may be used at the ends and along the sides for moving the loaded box.

Twenty-Five Man Fire-Tool Boxes.

Two of the more important boxes of a three-box unit used for storing and transporting a complete 25-man tool outfit are illustrated (figs. S-10, S-11). The third box used in the unit is very similar to the larger of the two shown. These boxes can be constructed from any lumber available. The lids are fastened with three strap hinges of a suitable size. The corners and edges are reinforced with light angle iron and metal box strapping. The handles are made of strap iron and ordinary galvanized-iron pipe of the proper size to withstand the weight of the loaded box. Partitions are installed suitable for accommodating the various tools necessary to meet local conditions.

Back-pack Water-Can and Hand-Pump Crate.

The box can be manufactured from any No. 1 grade 1- by 6-inch common lumber (fig. S-12). The ends may be bound to further strengthen the box. A box of approximately 27 by 18 inches by 19 inches deep, inside



FIGURE S-9.—Ten-man fire-tool box.



FIGURE S 10.—Twenty-five man tool box (one of three boxes).

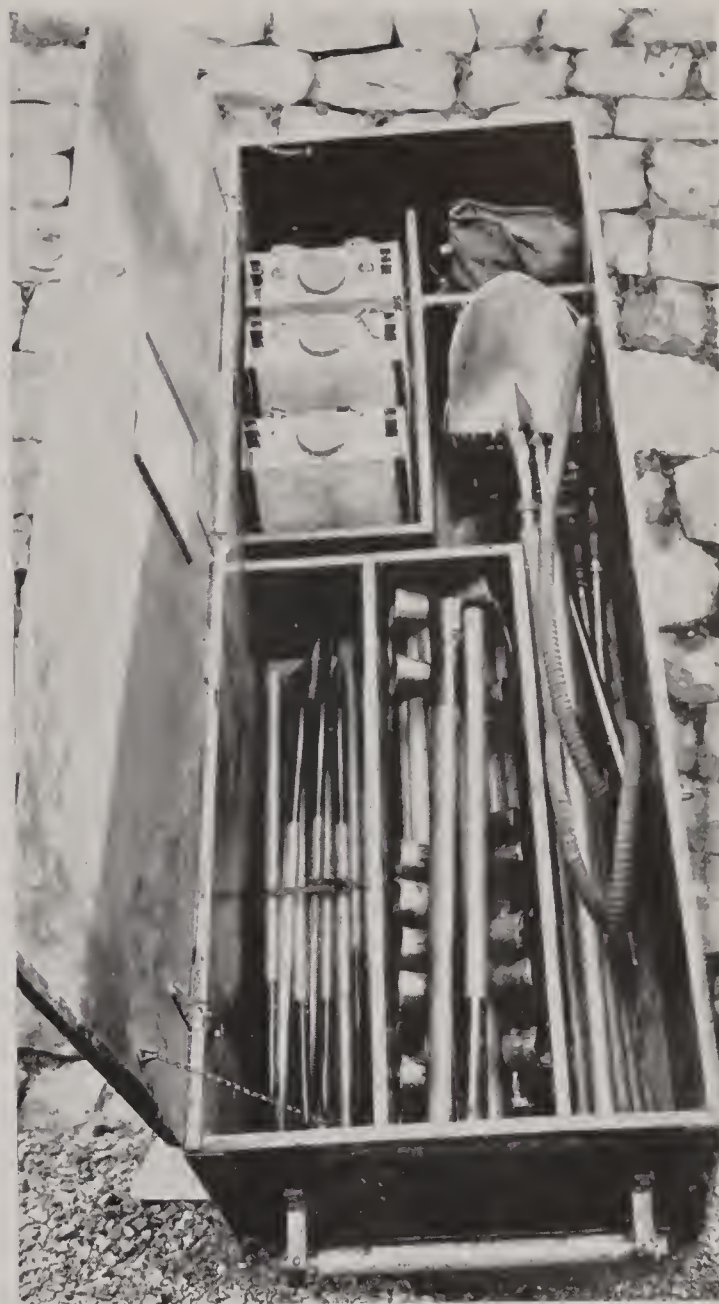


FIGURE S-11.—Twenty five man tool box (one of three boxes).



FIGURE S 12.—Back pack water can and hand-pump crate.



FIGURE S 13. Power-pumper outfit box.

measurements, will accommodate four back-pack water cans. Four pieces of $1\frac{1}{2}$ -inch fire hose are fastened to the under side of the lid and serve as sheaths for the hand pumps. (Measurements given are based upon standard back-pack cans.)

Power-Pumper Unit Box.

This particular box is provided with removable bottom and a solid partition throughout the box slightly above center (fig. S-13). This arrangement permits fastening the pumper to the bottom of the box and then setting the box over it and fastening the bottom thereto with four hinged staple hasps. The lid is hinged at one side and fastened with a hinged staple hasp at the other. The top portion of the box permits carrying all necessary accessories which should be included in a power-pumper unit. Extra-heavy chest handles should be provided on each end for handling the loaded box.

The box can be constructed from any good grade of 1-inch lumber and the edges should be reinforced with heavy metal box strapping. A suitable size of box to accommodate most types of pumpers is one 30 inches long, 26 inches high, and 18 inches wide, inside dimensions. The inside partition or shelf should be installed anywhere from 6 to 12 inches down from the top, according to the type of pumper unit to be contained. In addition to providing space for the pumper unit and all essential accessories, the box also provides space in the bottom portion for a 5-gallon can of gasoline and extra oil. Cleats and additional small partitions may be installed to accommodate the type of equipment to be carried.

Ax Boxes.

A very suitable type of ax box of a size sufficient to contain 12 axes can be constructed

from $\frac{3}{4}$ -inch material. To accommodate 12 axes of any pattern, the box should be 18 inches long, 8 inches high, and $5\frac{1}{2}$ inches deep, inside dimensions. In order to strengthen the box it should be bound with at least two bands, and preferably four, of metal box strapping going around the small way of the box. The two top endpieces should each be $3\frac{3}{4}$ inches in width. The top center hinged piece should be of the same width fastened upon the back side with two strap hinges and at the front with a hinged hasp and staple. This arrangement then leaves sufficient room for the double row of handles to protrude from the box.

If a six-ax box is desired, the following dimensions should be used: length, 12 inches, width, 8 inches, and depth, $5\frac{1}{2}$ inches. Instead of two solid endpieces and a hinged centerpiece being on the top as in the case of the 12-ax box there should be provided one solid endpiece 4 inches in width and one hinged endpiece of the same width at the opposite end of the box; otherwise the box is constructed in the same manner as the 12-ax container.

Adz-Eye Hazel-Hoe Box.

This box is suitable for containing 12 of the adz-eye type of hazel hoes (index No. MSF-179) handled and ready for use. It can be constructed from any good grade of 1-inch lumber of the proper width to provide one-piece sides and ends.

The required dimensions are approximately 41 inches long, $16\frac{1}{2}$ inches wide and 9 inches deep, inside measurements. As indicated in figure S-14, one of the crosspieces at one end of the box is fastened with two strap hinges on one end, and with a hinged hasp and staple at the other. This permits ready access to the tools.

The box should be bound at both ends with metal box strapping since the gross weight of 12 hazel hoes when handled is around 60 pounds.

Ax and Shovel Brackets. (Index No. 65.)

The ax and shovel brackets consist of four pieces which are made from strap iron and spring-steel strap. The shovel brackets are suitable for either the No. 0 or the No. 2 long-handled round-pointed shovels. The ax brackets are adapted to any type of ax. They are designed for use on the side of a truck bed or body where they may be fastened with $\frac{1}{4}$ -inch stove or carriage bolts. It is desirable to use either a piece of leather or web strap and buckle with each handle clip, if rattling is to be eliminated entirely. The strap is



FIGURE S-14.—Hazel-hoe box.

bolted to the bed with the same bolts which hold the clip. These brackets may be procured through the Supply Depot or can very easily be manufactured from the specifications contained in the master file.

Parachute, Freight.

Region 1 has been able to obtain a considerable number of condemned Army parachutes from the War Department at little or no cost. These parachutes are still quite serviceable and are entirely adaptable for use in dropping supplies and equipment in remote areas. They are particularly useful in delivering such items as portable power pumps and other articles of more or less fragile nature. Region 1 has conducted tests with these chutes in dropping power pumps and has found it to be entirely practicable.

Refer to part 3 of the handbook for further information in regard to the preparation of supplies and equipment for aerial transportation. It would seem that condemned Army parachutes could be made very useful to many of the Forest Service Regions. It is therefore suggested that application be made to the War Department for this particular item of equipment by those units having need for it.

Kerosene Can, 1-Pint Size. (Index No. 78-1-S.)

This can is a standard product of the American Can Co. and is particularly adapted for carrying kerosene to use upon saws. The can is of the proper size to be carried in the hip pocket. It may also be used for many other purposes.

Specification.—A rectangular can $3\frac{7}{8}$ by $1\frac{3}{4}$ inches by $5\frac{7}{8}$ inches high, outside dimensions, with rounded corners. Made of 80-pound, or heavier, tin plate with 1-inch screw top thoroughly oilproof.

Kerosene Can, ½-Gallon Size. (Index No. 78-2-S.)

This can is made on the same order as the 1-pint can except for dimensions. It is very useful for carrying oil for portable power equipment and also gasoline for lights, etc.

Specification.—A rectangular can $3\frac{1}{2}$ by $5\frac{1}{8}$ inches, by $7\frac{3}{8}$ inches high, outside dimensions, corners slightly rounded. Made of 80-pound, or heavier, tin plate with $1\frac{3}{4}$ -inch screw top thoroughly oilproof.

Kerosene Can, 1-Gallon Size. (Index No. 78-3-S.)

Similar in design and construction to the 1-pint and ½-gallon cans but larger in size. This

can as well as the others is also a standard product of the American Can Co. It is suited for transporting gasoline and other oils where a greater quantity is desired than can be carried in the smaller cans.

Specification.—A rectangular can $6\frac{1}{4}$ by $4\frac{1}{4}$ inches, by $8\frac{3}{8}$ inches high, outside dimensions. Made of 80-pound, or heavier, tin plate. It has a screw top approximately $1\frac{3}{4}$ inches in diameter thoroughly leakproof against kerosene and other oils.

Mineral Oil. (Refer to handbook, part 3, Care of mess equipment.)

Hard-boiled Hat. (Index No. 177.)

This is a rigid hat such as is used to protect steel workers, miners, and others similarly occupied, from head injuries. Its use in connection with fire control is to protect sawyers from falling embers, limbs, and bark.

Transparent Material. (Index No. MSF-233-S.)

The following specification will provide a suitable material for the manufacture of transparent silhouettes, protractors, triangles, and other items of a similar nature. Several of the Forest Service Regions have used this material for these various purposes and find it to be entirely satisfactory because of adaptability to either plate printing or to drafting work. The material may be obtained in various thicknesses by 0.005 inch graduations, from 0.005 inch up to and including 0.090 inch.

Specification.—A noninflammable, colorless, transparent material, equal to celluloid, Pyrolin, Plastacele, etc., for pliability. Thickness shall be as specified, and the material shall be provided in sheets approximately 20 by 50 inches in size. The material must be of such transparency as to permit reading ordinary typewriting on white paper beneath a sufficient number of sheets to create 0.50 inch thickness, when placed upon an ordinary table in daylight conditions.

The material furnished shall not warp or discolor when exposed to the sunlight or when used over a lighted drafting table using heavy-duty electric lamps.

The noninflammability feature of the material must be such that when it is placed in direct contact with an open flame for a period of 10 seconds and then removed therefrom it shall not continue to burn.

PART TWO
FOREST FIRE DANGER MEASURING EQUIPMENT

PART TWO

FOREST FIRE DANGER MEASURING EQUIPMENT

Purpose and Methods of Measuring and Rating Forest Fire Danger.¹

The purpose of forest fire-danger rating is to provide a measuring stick by which the severity of the fire-control problem on any forest unit may be compared with that on other units or with that on the same unit during different days, seasons, or years. Such a measure of protection needs is essential to the equitable distribution of protection funds between different administrative units and to insure the most efficient use of protection effort within the administrative unit.

Fire-danger rating to serve this purpose requires the measurement and integration of all the various factors which influence fire danger on a numerical basis which can be given a uniformly specific meaning. Experience over many years has indicated that rarely can any two men be expected to arrive at the same estimate of fire danger when judging the same factors, no matter how well versed they be in fire-suppression practice. Nor can they be expected to give the same interpretation to such definitions of fire danger as extreme, high, or low. The sum of the properly measured and weighted factors which contribute to fire danger can, however, be assigned a numerical rating which will express the relative degree of fire danger at the time and place the factors are measured.

The principal factors which have an important influence on fire danger are: (1) Season, (2) fuel moisture content, (3) relative humidity, (4) wind velocity, (5) precipitation, (6) risk, or the degree and class of exposure to fire-starting agencies, (7) herbaceous stage of development, (8) visibility distance, (9) fuel cover type, and (10) topography. These factors, however, do not all exert the same influence and some are more important than others. Only through a large amount of experimental work, supported by the seasoned judgment of men with long and varied experience in fire-control work, can the proper relative weights be assigned to the respective factors and a properly interpreted result be obtained.

Some of the fire-danger factors remain constant on any given forest unit, while others vary with the season and from one day to the

next. The condition of the fuel, the weather elements which influence its inflammability, season of the year, lightning, and visibility conditions influencing the detection of fires by lookouts, must therefore be measured daily if an accurate estimate of current relative fire danger or a true conception of the actual character of the fire season is to be obtained. It is primarily with these fluctuating factors that the forest or ranger district administrator is concerned.

The usual protection unit in national-forest administration is the ranger district. In order to secure reliable measurements of the factors enumerated which will be representative of areas as large as most ranger districts, it is necessary to measure each factor simultaneously at several well-chosen locations on the area and obtain the average value of each factor measured. This is done by establishing fire-danger stations manned by regular protection personnel and equipped with the necessary instruments and devices for uniformly measuring the variable weather and fuel factors required by the danger-rating scheme. These stations do not substitute for the regular fire-weather stations maintained in cooperation with the Weather Bureau, but they do provide supplementary weather data. The purpose of the fire-danger station is to provide for the measurement of current fuel inflammability, while that of the fire-weather station is to provide data for localized weather forecasts.

The instruments employed at fire-danger stations are designed for measuring fire-danger factors and are used chiefly for this purpose only. Because of the nonavailability or excessive cost of instruments required in this field, the Forest Service has developed a number of new fire-danger measuring instruments and devices and has made use of economical adaptations of standard meteorological instruments. Description data and specification index numbers will be found for many of these instruments in this section of the handbook immediately following.

To obtain the current fire-danger rating for any unit, the measurements of each fire-danger factor obtained at the different fire-danger stations are averaged. The average values obtained are then referred to a set of integration tables or charts (see Board, fire danger, R-6, and Meter, fire danger, R-1), which show the fire-danger rating for any combination of values of the fire-danger factors used.

¹ For detailed information concerning the measurement and integration of fire-danger factors and the application of fire-danger ratings in the Northern Rocky Mountain Region see the following: GIBBORNE, H. T. MEASURING FIRE WEATHER AND FOREST INFLAMMABILITY. U. S. Dept. Agr. Cir. 398, 59 pp., illus. 1936. For sale by Superintendent of Documents, Washington, D. C., at 10 cents.

In order to properly compare data secured at different stations and on different ranger districts and forests, it is essential that the same factors be measured in the same way at each fire-danger station and at the same time of day for all stations within a Region—or at least within groups of forests having similar climatic characteristics.

It is customary to divide the numerical fire-danger ratings into classes of fire danger. The number of classes from no fire danger—requiring no organized protection—to the greatest fire danger experienced—requiring the manning of all regular protection positions plus available emergency forces—is normally determined by the number of administrative steps which can be recognized between these two extremes—a usual maximum of about seven.

In Regions of uniform climate, cover type, and topography, each fire-danger class may require uniform administrative action throughout the area. Thus in the Northern Rocky Mountain Region, it is possible to incorporate specific administrative instructions in the fire-danger meter for each danger class which apply throughout western Montana and northern Idaho. In Regions having a variety of climates, cover types, and topography, on the other hand, the same fire-danger class may require decidedly different fire-control action in the areas having different fire problems because of the varying relative importance of the different fire-danger factors. In such Regions it is necessary to adapt the ratings for localized use by providing for each danger class specific administrative instructions in the individual ranger district or other protective unit fire plan which apply to that unit only.

The determination of current fire danger is not the only purpose served by the measurement and recording of weather and fuel conditions. Properly recorded data accumulated over a period of time serve as a basis for general conclusions regarding fire-danger factors in given Regions and localities. Seasonal trends may be determined from them and normals by 10-day or other periods may be established indicating the probable conditions which can normally be expected at any time during the season. These data also permit correlation between fire danger and fire weather thus making possible better utilization of short-period, localized, fire-weather forecasts. The importance of keeping complete and accurate records for each fire-danger station and for each protection unit thus cannot be overstressed. See the last section of this part of the handbook for suggested record forms.

Forest Fire-Danger Measuring Equipment

The items listed on the following pages have been developed for use in fire-danger measuring and rating. Standard meteorological in-

struments, for the most part, have been omitted since they are adequately described in available publications. Optional equipment is listed where different items are employed in different Regions for the same purpose. The same indexing and referencing scheme has been used in this part of the handbook as in part 1. Specifications, where indicated are likewise available from the master specification file the same as for equipment items listed within part 1.

Forest Fire-Danger Meter, Region 1 Type.¹ (R1-X.)

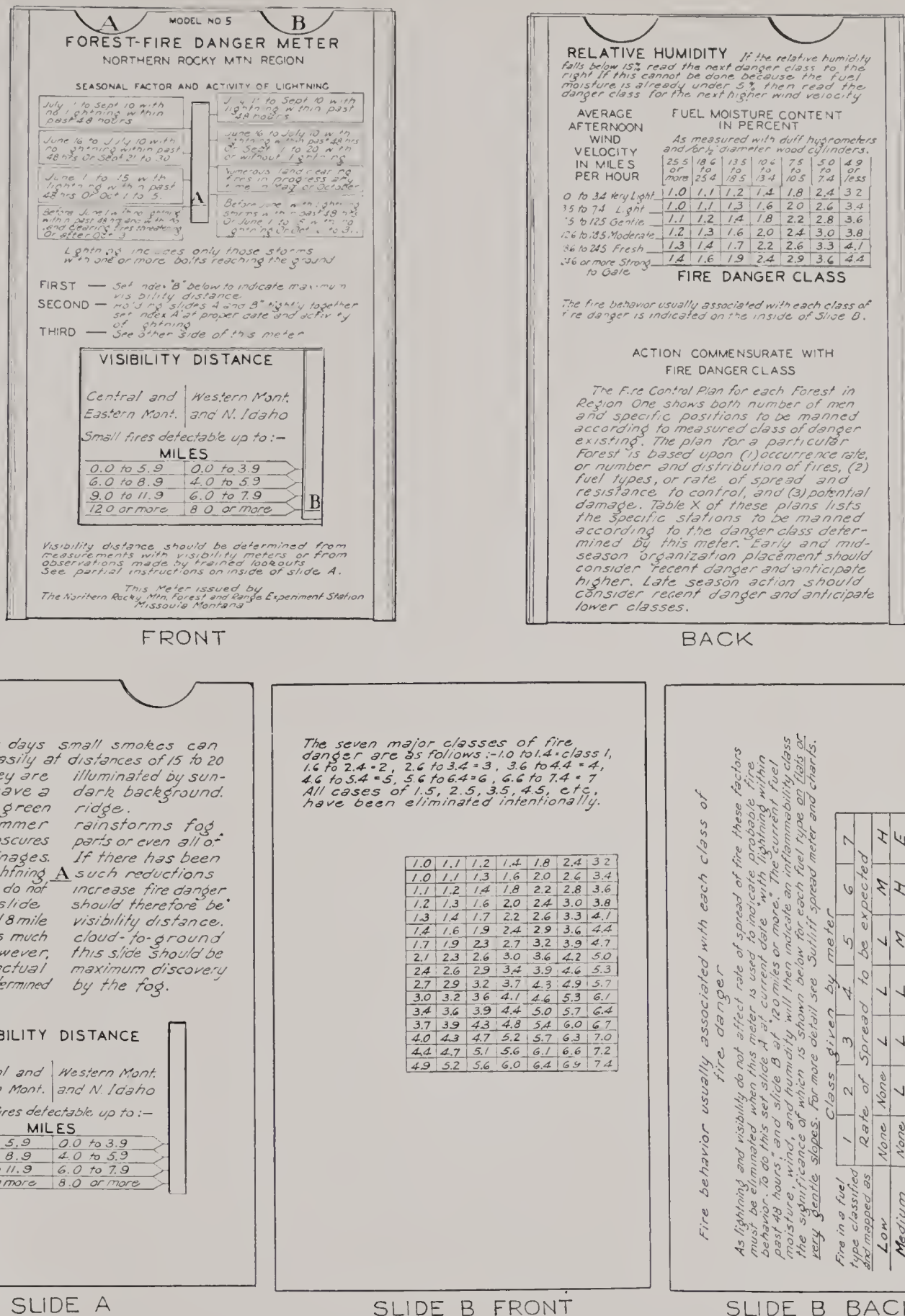
The northern Rocky Mountain fire-danger meter (fig. 2-1) is designed to properly integrate seven important factors which have a combined effect upon fire danger. The factors integrated by the Region 1 meter are (1) season, (2) lightning, (3) land-clearing and other debris fires, (4) visibility distance, (5) relative humidity, (6) fuel moisture, and (7) wind velocity. Use of the meter makes possible a degree of uniformity in rating fire danger, not attainable by ratings evolved through judgment by different observers considering the same factors. The meter is a cardboard device 4 by 6 inches, having two slides which are set by the operator in accordance with measurements of the seven factors enumerated. Current fire danger is rated on a scale of seven classes, each representing a specific probable rate of spread of fire, and each requiring specific administrative action.

The danger meter is designed for use in the Northern Rocky Mountain Region. Its use elsewhere, without modification, is not advocated unless or until local tests prove that the relative weights given to each of the several factors for Region 1 conditions meet local requirements elsewhere.

Fire-Danger Board. (R6-X.)

A fire-danger board has been developed and adopted as an important part of the fire-danger rating scheme for Region 6 (fig. 2-2). The board summarized the variable factors of fire danger measured at all the fire-danger stations within a ranger district or other protection unit and combines them into readily usable fire-danger ratings that are closely correlated to pre-suppression action by the ranger's fire plan. The board is displayed in a conspicuous place in each district ranger's office during the fire season and posted daily. Each supervisor's office will have a board which will summarize conditions on the entire forest. When supplemented by the fire-weather warning service of the United States Weather Bureau, the board makes a complete system for keeping abreast of current fire danger.

¹ Reference: U. S. Department of Agriculture Circular 398.



A

On clear days small smokes can be seen easily at distances of 15 to 20 miles if they are illuminated by sunlight and have a dark background, such as a green ridge.

After summer rainstorms fog frequently obscures entire drainages. If there has been little or no lightning such reductions of visibility do not increase fire danger and this slide should therefore be set at 12 and 8 mile visibility distance. If there was much lightning, however, set at the actual distance determined by the fog.

VISIBILITY DISTANCE

Central and Western Mont.
Eastern Mont. and N. Idaho

Small fires detectable up to:—

MILES	
0.0 to 5.9	0.0 to 3.9
6.0 to 8.9	4.0 to 5.9
9.0 to 11.9	6.0 to 7.9
12.0 or more	8.0 or more

SLIDE B FRONT

The seven major classes of fire danger are as follows: 1.0 to 1.4 = class 1, 1.6 to 2.4 = 2, 2.6 to 3.4 = 3, 3.6 to 4.4 = 4, 4.6 to 5.4 = 5, 5.6 to 6.4 = 6, 6.6 to 7.4 = 7. All cases of 1.5, 2.5, 3.5, 4.5, etc., have been eliminated intentionally.

1.0	1.1	1.2	1.4	1.8	2.4	3.2
1.0	1.1	1.3	1.6	2.0	2.6	3.4
1.1	1.2	1.4	1.8	2.2	2.8	3.6
1.2	1.3	1.6	2.0	2.4	3.0	3.8
1.3	1.4	1.7	2.2	2.6	3.3	4.1
1.4	1.6	1.9	2.4	2.9	3.6	4.4
1.7	1.9	2.3	2.7	3.2	3.9	4.7
2.1	2.3	2.6	3.0	3.6	4.2	5.0
2.4	2.6	2.9	3.4	3.9	4.6	5.3
2.7	2.9	3.2	3.7	4.3	4.9	5.7
3.0	3.2	3.6	4.1	4.6	5.3	6.1
3.4	3.6	3.9	4.4	5.0	5.7	6.4
3.7	3.9	4.3	4.8	5.4	6.0	6.7
4.0	4.3	4.7	5.2	5.7	6.3	7.0
4.4	4.7	5.1	5.6	6.1	6.6	7.2
4.9	5.2	5.6	6.0	6.4	6.9	7.4

SLIDE B BACK

Fire behavior usually associated with each class of fire danger

As lightning and visibility do not affect rate of spread of fire these factors must be eliminated when this meter is used to indicate probable fire behavior. To do this set slide A at current date, "with lightning within past 48 hours" and slide B at "120 miles or more." The current fuel moisture, wind, and humidity will then indicate an inflammability class the significance of which is shown below for each fuel type on slides A and B. Very gentle slopes. For more detail see Sullist spread meter and charts.

Fire in a fuel type classified and mapped as	Class given by meter						
	1	2	3	4	5	6	7
Low	None	None	L	L	L	M	H
Medium	None	L	L	L	M	H	E
High	L	L	L	M	H	E	E
Extreme	L	M	M	H	E	E	E

B

This is Model No. 5, issued in 1933

DESTROY ALL PREVIOUS MODELS

FIGURE 2-1.— Northern Rocky Mountain fire-danger meter.

Color psychology has been used to advantage in the fire-danger board. The boards are 18 by 24 inches in size. Each factor of fire danger that has a place on the board is divided into classes and each class is assigned a color. For example, fuel moisture content as measured by the 1/2- by 1/2-inch ponderosa pine sapwood fuel-moisture-indicator sticks is represented by five classes and colors as follows: Class 4, 0 to 7 percent, red (this is, of course,

the most dangerous condition); class 3, 8 to 10 percent, orange; class 2, 11 to 18 percent, blue; class 1, 19 to 25 percent, green; and class 0, over 25 percent, white. By means of disks mounted behind the face of the board the class number and color of the current condition are displayed through an opening in the board by turning a knob attached to the disk. This objective presentation of current conditions arrests the attention of all who see it. Thus a

glance at the board may show a red fuel condition, white relative humidity, green wind, red herbaceous stage, orange risk, and red visibility. When all these factors are combined (by means of the simple integration tables mounted on the face of the board) they may produce a class-5 day which will be shown in

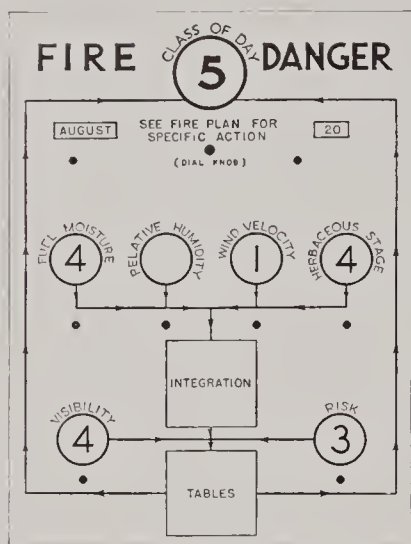


FIGURE 2-2.—Region 6 fire-danger board.

orange in the large opening at the top of the board. The class of day shown on the board indicates the action to be taken according to the ranger's fire plan.

In addition to the fuel-moisture content factor shown on the board in five classes and colors, relative humidity (two classes), wind velocity (four classes), and herbaceous stage (three classes) have colored dials on the board because they are the principal physical variables that determine fire behavior. The herbaceous-stage factor is an estimate of the current fire-danger status of the annual growth of vegetation such as grass, ferns, and weeds. When the annuals are green and succulent, they do not add to the fire danger and may even be a retardant. As the season progresses and they become drier and drier, they materially add to the fire danger. Although other physical factors, for example kind and quantity of fuel, and topography, vary from place to place and may be of major importance in determining what a fire will do when burning conditions are ripe, such factors have not been included as variables in rating current fire danger because they remain practically constant throughout the fire season (except changes in fuels, and this has been taken care of in the herbaceous-stage item on the board).

The current status of fuel-moisture content, relative humidity, wind velocity, and herbaceous stage are combined in the first of the two integration tables and produce a burning index. The next step is to arrive at the sum total fire-danger condition for the purpose of determin-

ing what action should be taken—how many fireguards, lookouts, and patrolmen are needed—which is the end result desired from the board. In order to get this, visibility conditions (measured by Byram haze meters) and risk (the relative activity of the fire-starting agencies—man, lightning, etc.) also have a place on the board. These two factors of fire danger are combined with the burning index and produce one of seven classes of day. Each district ranger will have a fire plan, prepared in advance, stipulating the action he will take to meet each class of day. For example, a class-4 day calls for a normal number of positions to be manned and each position will be listed in the ranger's fire plan. A class-7 day calls for all available forces and the ranger's plan will specify what that means.

Alignment Charts for Duff Moisture. (Northeastern Forest Experiment Station—X.)

The Northeastern Forest Experiment Station has developed an alignment chart from which surface duff moisture content and hazard may be computed from the three meteorological factors: (1) Number of hours since last measurable precipitation, (2) current air temperature, and (3) current relative humidity. Three alignment charts with tables showing comparative surface duff moisture contents in the open and within the forest are used for observations at 11 a. m., 2 p. m., and 5 p. m. Figure 2-3 illustrates the chart used for 11 a. m. observations. A straightedge is placed on the chart intersecting the precipitation-hour scale and the air-temperature scale at their respective values and the point at which the straightedge intersects the unmarked vertical line is noted. The straightedge is then moved so it passes through this point and intersects the relative-humidity scale at the proper value. Surface duff moisture content and hazard in the open are read at the point of intersection of the straightedge on the moisture-content hazard scale. The broken lines in the figure numbered (1) and (2) illustrate the positions of the straightedge in determining surface duff moisture content 75 hours after last measurable precipitation when air temperature is 50° F. and relative humidity is 47 percent. Moisture content of surface duff in the open is 20 percent and the hazard is medium.

The charts are used to determine in specific terms current fire hazard and in conjunction with daily weather forecasts may be used to predict local probable changes in hazard. The charts were developed for use in the forests characteristic of New York, Connecticut, Massachusetts, and Maine.

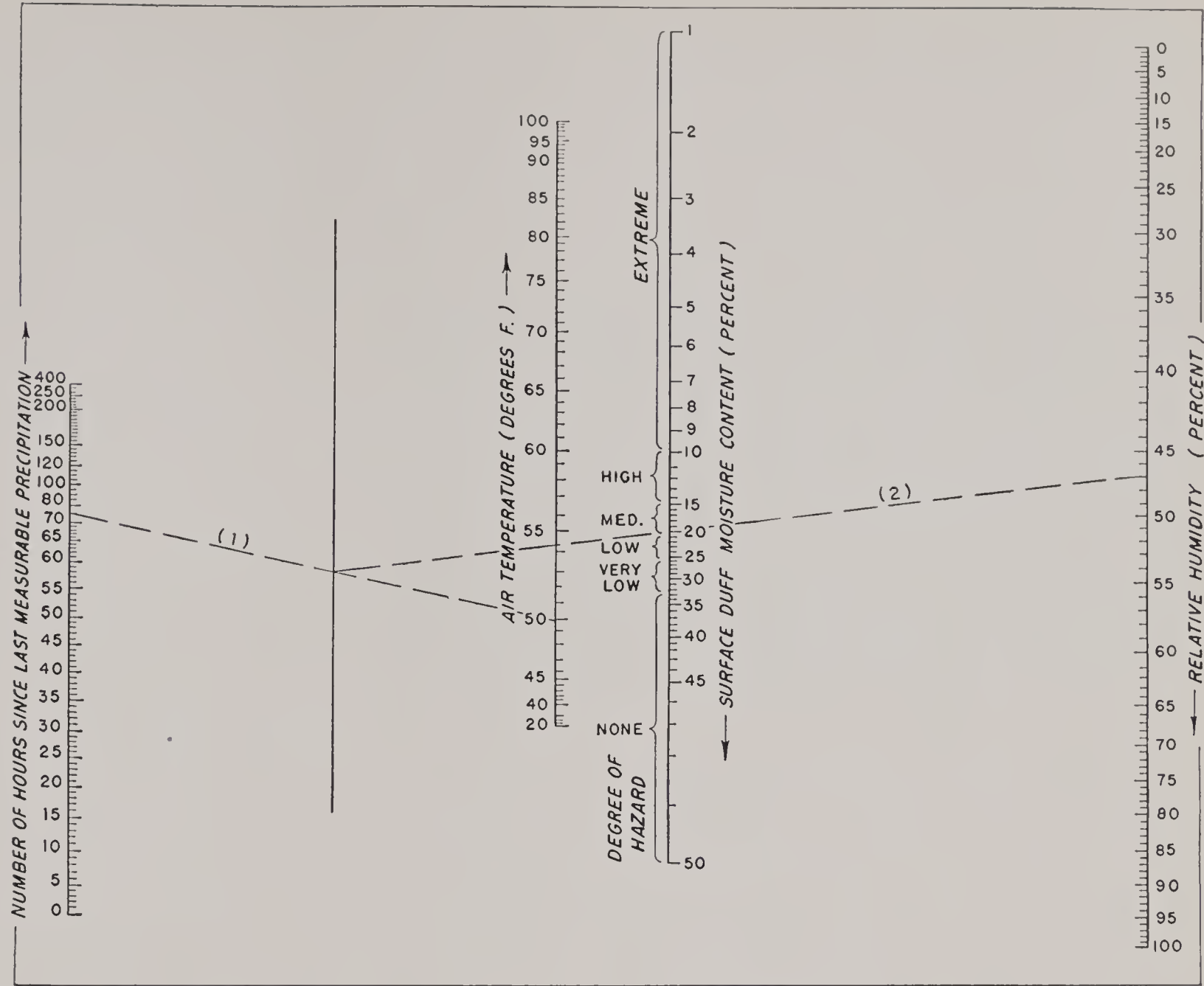


Table showing the relationship between surface duff moisture content in the open and within the forest at 11:00 A.M.

Open %	Forest %	Open %	Forest %	Open %	Forest %	Open %	Forest %	Open %	Forest %
2	12	11	34	21	46	31	49	41	50 or more
3	15	12	36	22	46	32	50 or more	42	" "
4	18	13	38	23	47	33	" "	43	" "
5	21	14	39	24	47	34	" "	44	" "
6	24	15	40	25	48	35	" "	45	" "
7	26	16	41	26	48	36	" "	46	" "
8	28	17	42	27	48	37	" "	47	" "
9	30	18	43	28	49	38	" "	48	" "
10	32	19	44	29	49	39	" "	49	" "
		20	45	30	49	40	" "	50	" "

FIGURE 2-3.—Alinement chart for 11 a. m. observations for estimating duff moisture content and hazard of white pine duff.

Fuel-Moisture-Indicator Sticks, Region 1 Type. (R1-X and R1-P.)

The Region 1 fuel-moisture-indicator sticks are used to determine the moisture content of fuels, which in turn represents one of the principal factors in rating forest-fire danger. The sticks are in the form of cylinders turned to ½ inch and 2 inches in diameter, respectively, and are exactly 18 inches long. Only clear ponderosa pine sapwood with no defects is

used. The large sticks are exposed singly and the small ones in groups of three fastened together with hardwood dowels.

Before shipping to the field the sticks are examined by the Northern Rocky Mountain Forest and Range Experiment Station for uniformity of behavior upon exposure to the weather and the dry weights are determined. Moisture contents of the sticks are measured in the field by weighing the sticks on the triple-

beam scales (MSF-463). The sticks are exposed uniformly 10 or 12 inches *about* the ground under the screen designed for this purpose.

Forest Service units desiring this type of equipment should secure it through Region 1.

Fuel-Moisture-Indicator Stick Screen. (Index No. 466.)

When fuel-moisture-indicator sticks are exposed to full sunlight the result is the measurement of the extreme of fire danger rather than the danger typical of the general location. Sticks exposed in timber stands, on the other hand, do not give comparable results throughout an administrative unit because of differences in the degree of shading. Region 1 has designed a screen under which the sticks are uniformly exposed in the open to overcome these difficulties. The screen is mounted on an angle-iron frame 35 inches square with legs holding the screen 13 inches above the ground. Two layers of 14-mesh screen provide a degree of shade approximately equivalent to that of an old-growth forest area from which three-fourths of the canopy has been removed.

Fuel-Moisture-Indicator Sticks, Region 6 Type. (R6-X and R6-P.)

The Region 6 fuel-moisture-indicator sticks differ from the Region 1 sticks principally in that they are square. These sticks also are made in sizes of $\frac{1}{2}$ inch and 2 inches, the former being of clear ponderosa pine sapwood and the latter of Douglas fir heartwood. The small sticks are made in groups of three joined together with dowel pins and are trimmed to an exact oven-dry weight of 100 grams. The large sticks are trimmed to a dry weight of 400 grams.

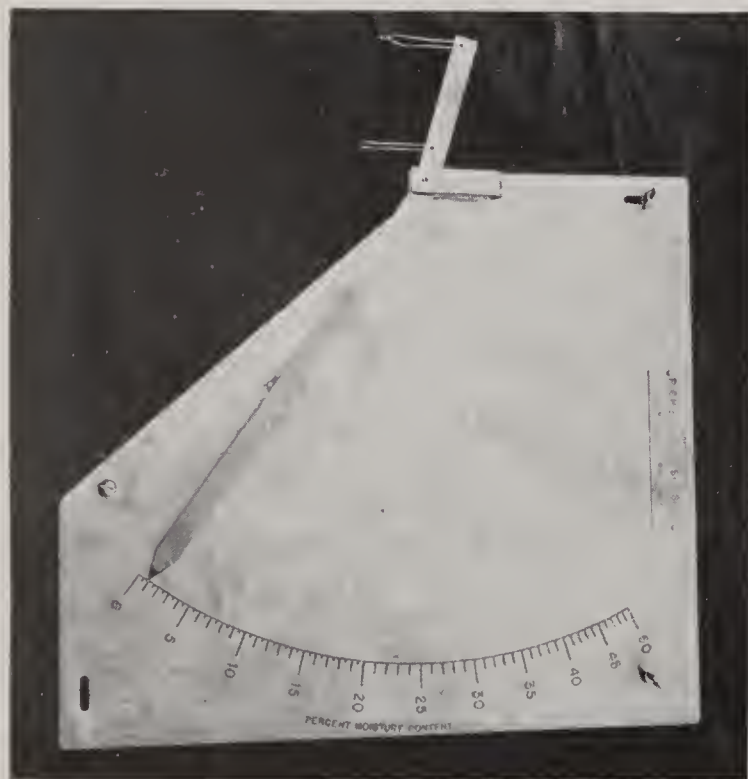


FIGURE 2-4. Region 6 type fuel-moisture-indicator stick scale.

The sticks are exposed in the field on wire brackets 6 or 8 inches above the ground usually within the timber stands for which the fuel-moisture measurements are desired. Moisture contents of both sizes of sticks are determined directly in percent by weighing on the hazard-indicator stick scale illustrated in figure 2-4.

The sticks are used chiefly as indicators of relative fuel-moisture content. The large sticks are used principally to indicate the seasonal cumulative drying trends but are rarely used to represent actual current fuel-moisture content. The small sticks indicate the short-period diurnal trends in the moisture content of light fuels although they do not represent moisture conditions in any one type of fuel or necessarily the average moisture content of a group of fuels. Dry sticks, however, mean dry fuels; and wet sticks, wet fuels, and the degree of variation in stick-moisture contents has been found to agree well with corresponding variations in moisture contents of the fuels.

Triple-Beam Scale. (Index No. MSF-463.)

A triple-beam laboratory trip scale which is recommended for use in determining the weights or Region 1 type fuel-moisture-indicator sticks from which their moisture contents are computed. The scales have a capacity of 1,000 grams with an accuracy of 0.10 gram from 0 to 50 grams and 0.50 gram from 500 to 1,000 grams. Three beams with sliding weights are graduated to 10 grams by 0.10 gram, 100 grams by 10 grams, and 500 grams by 100 grams, respectively.

Fuel-Moisture-Indicator Stick Scale. (Index No. 461. R6-X and R6-P.)

The fuel-moisture-indicator stick scale provides a means for readily measuring the moisture contents of 100-gram and 400-gram sticks in percent without the necessity for computations or tables (fig. 2-4). The scales have a capacity of 0 to 50 percent and are accurate within plus or minus 0.25 percent from 0 to 20 percent and within plus or minus 0.5 percent from 21 to 50 percent. These scales are for use only with moisture-indicator sticks having oven-dry weights of exactly 100 and 400 grams, respectively. They are constructed of brass and are furnished with test weight, brackets for mounting, and packing box.

Fan Psychrometer. (Index No. MSF-457.)

The fan psychrometer consists of a standard sling psychrometer without handle mounted on a supporting bracket, a small bottle of water, and a fan with a hand-operated rotating device. The wet-bulb thermometer is mounted directly over the bottle of water and the wicking is long enough to extend into the water. The rotation of the fan circulates air past the two thermometer bulbs.

Advantages of the fan psychrometer over other types are:

1. Breakage of thermometers is reduced to a minimum because the thermometers are stationary.

2. The operator can watch the descent of the mercury in the wet-bulb thermometer and determine accurately the low point, thus adding materially to the probability of getting an accurate relative-humidity determination.

The fan psychrometer is recommended for use only in a suitable instrument shelter. Where suitable shelters are available it is considered superior to the sling-type psychrometer.

Sling Psychrometer, Pocket Size. (Index No. MSF-458.)

The pocket size sling psychrometer is the most portable device for determining relative humidity and is therefore a valuable instrument for field use. Thermometers are mercury-in-glass, stem graduated in whole degrees; the usual range is $+25^{\circ}$ to $+120^{\circ}$ F. The thermometers are mounted on an aluminum or dural back to which is attached a metal chain 12 inches long equipped with a swivel handle by which the instrument is whirled. Psychrometers are furnished in leather-covered metal-reinforced cases approximately 8 inches long, $1\frac{1}{2}$ inches wide, and $\frac{3}{4}$ inch thick.

Psychrometer Wicking. (Index No. MSF-459-S.)

Only clean unsized cotton braided tubing should be used for wet-bulb wicks on all types of psychrometers. Wicking may be secured in spools of one gross yards from the following firm and upon the following specification. Wicking should be cut to size—about 3 inches long—and put up in envelopes, about 10 wicks per envelope, for convenient field use.

Specification.—(Quantity and cost make bids unnecessary.) The wicking can be obtained from United Lace & Braid Manufacturing Co. Auburn, Providence, R. I. Specify *braid No. 219, unsized, to be used as a cover for wet-bulb thermometers on relative-humidity measuring instruments.* Gross yard spools is smallest quantity sold. Price about \$1.10 per gross yards. On gross yards make 1,728 wicks 3 inches long.

Duff Hygrometer. (R. 1-X and Mad. Lab.-P.)

The duff hygrometer consists of a moisture-sensitive rattan element connected by means of a foxtail chain to an indicating pointer (fig. 2-5). When the hygrometer is inserted in the duff the moisture content of the rattan soon approaches equilibrium with the relative humidity within the duff layer. The changing

length of the rattan with changes in its moisture content actuates the pointer. The instrument is calibrated by letting it come to equilibrium with duff of a known moisture content or with a known relative humidity for which equilibrium fuel-moisture values have previously been determined. Duff-moisture-content values are read directly on a suitable scale under the pointer. The instrument is left in place on the forest floor during the fire

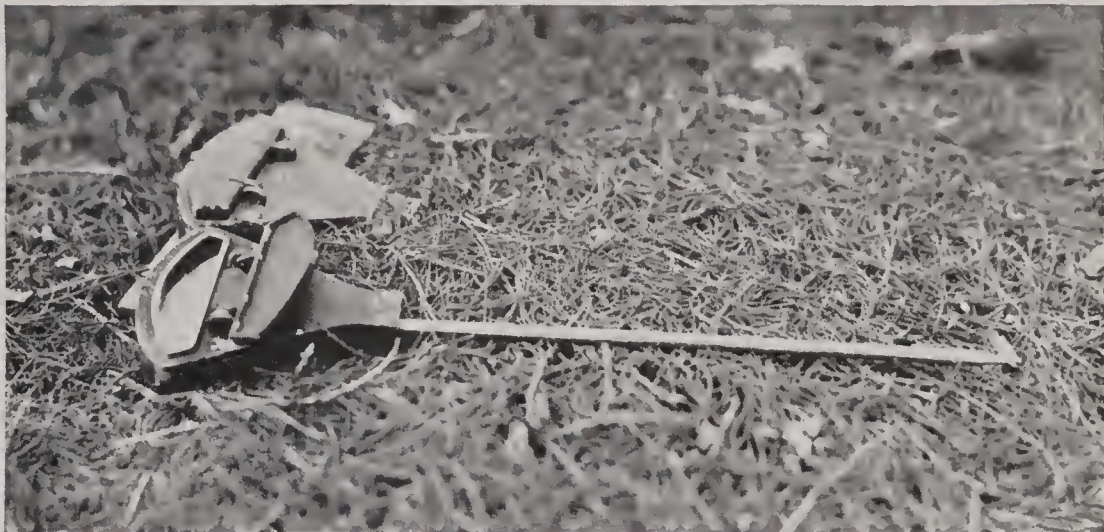


FIGURE 2-5.—Duff hygrometer. The instrument shown is properly inserted in the duff.

season. The duff hygrometer was developed for use in the white pine and Douglas fir regions but has been widely used elsewhere in other fuel types. It must be calibrated each year.

Forest Service units desiring to purchase duff hygrometers should do so through the Madison Laboratory where the instruments can be accurately calibrated.

Wind Gage. (R. 1-X and R. 6-X.)

To provide more accurate estimates of wind velocity at fire-control stations on the national forests than can be obtained by the Beaufort scale, various models of inexpensive wind gages have been developed in Regions 1 and 6. Several instrument companies have recently become interested in the commercial production of low-cost anemometers suitable for Forest Service use. The final development of these will remove the necessity for further development of the Forest Service gages. Those who are interested in this particular item of equipment should make inquiries direct to Region 1 or 6 for the latest developments and specifications.

Rain Gage and Measuring Stick, Forest Service Standard. (Index No. MSF-451.)

The Forest Service standard rain gage is similar to the standard Weather Bureau pattern except in size and materials. Capacity of the gage is 6 inches of precipitation. The gage is constructed of 26-gage galvanized-iron except the inner tube which is of seamless brass tubing. Tests conducted at the Northern

Rocky Mountain Experiment Station indicate very close agreement between this and the standard Weather Bureau gage. The principal advantage of the Forest Service gage is its low cost.

The measuring sticks used with the Forest Service rain gage are of red gum heartwood of suitable size with graduations applied with a rubber stamp. Smallest division is 0.01 inch of precipitation.

Measurements made with this equipment are not reported to the Weather Bureau as standard measurements.

Visibility Meter, Byram Type. (Index No. 456. R6-X and R6-P.)

The Byram haze or visibility meter is a simple instrument designed to determine the distance forest-fire lookouts can be expected to

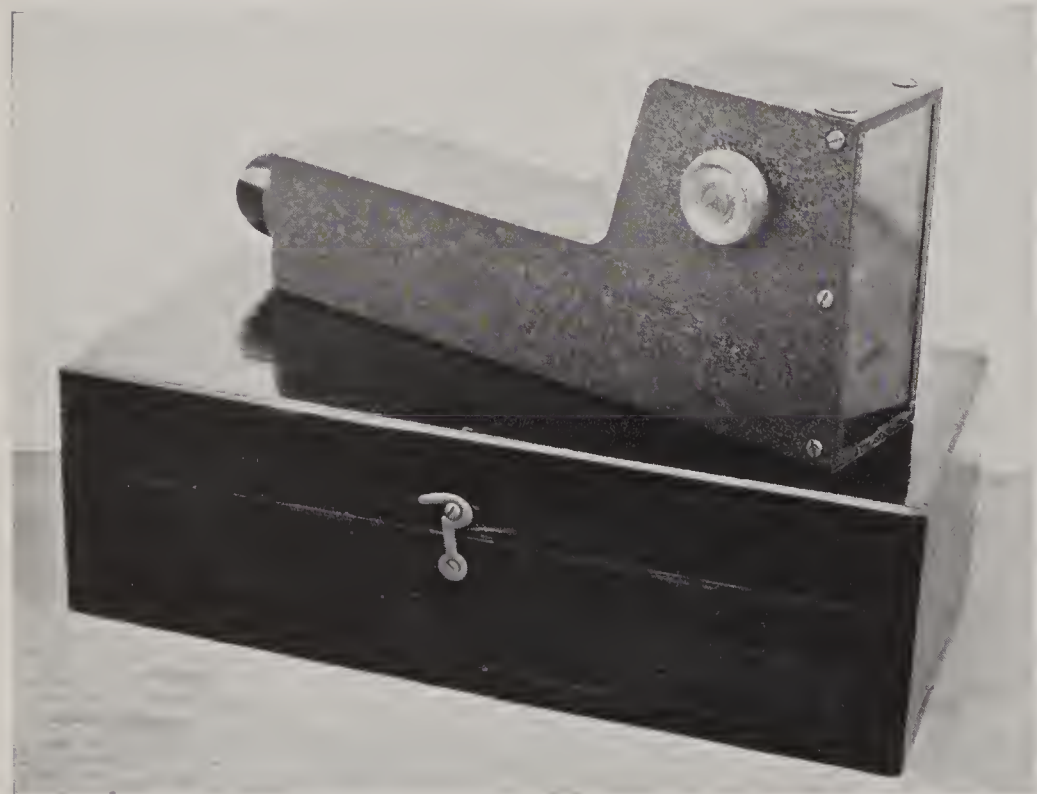


FIGURE 2-6.—The Byram visibility meter.

see the smoke from a small fire under existing atmospheric conditions (fig. 2-6). Experiments in Region 6 have shown that a standard size smoke column is just visible against a background 60 percent as bright as the horizon brightness in the same direction. By means of suitable filters and a rotating mirror incorporated in the meter, an observer is able to select a point in the landscape such as a ridge, having a brightness 60 percent of that of the horizon. The distance of this point from the observer may be scaled off on a map and is the visibility distance in that direction at the time of observation.

Maximum Thermometer, United States Weather Bureau Standard. (Index No. MSF-471.)

The maximum thermometer is a mercury-in-glass thermometer graduated in whole degrees

mounted on a stainless metal back. The thermometer is used to determine the maximum air temperature attained during any period, usually 24 hours. A constriction just above the bulb permits mercury to rise in the thermometer tube when the bulb is heated, but causes the mercury column to break and remain stationary in the tube when the mercury volume in the bulb decreases with lowering temperatures. The thermometer is reset by vigorously whirling, causing the mercury to be forced back through the constriction by the centrifugal force set up.

Minimum Thermometer, United States Weather Bureau Standard. (Index No. MSF-472.)

The minimum thermometer is a colorless alcohol-in-glass thermometer, stem graduated in whole degrees, and mounted on a stainless metal back. Minimum temperatures are indicated by a small black-glass double-ended index inside the bore. When the temperature decreases, the index is pulled toward the bulb end of the thermometer by the surface tension of the end of the alcohol column. Increases in temperature cause the alcohol to flow past the index without moving it. The thermometer is reset by tilting it until the index slides down the bore to the end of the alcohol column.

Townsend Support, United States Weather Bureau Standard. (Index No. MSF-473.)

The Townsend support is a metal device for mounting maximum and minimum thermometers in instrument shelters. The fixture consists of a base plate attached to a horizontal crosspiece in the shelter by wood screws, upon which are mounted two projecting studs of unequal lengths carrying the thermometer clamps. The longer stud, with a pawl for locking and releasing the rotating shaft, holds the maximum thermometer and permits vigorous whirling to reset the thermometer. The shorter stud is provided with a stop pin to permit tilting of the minimum thermometer mounted upon it when the index is reset. The Townsend support holds the thermometers in the correct exposure positions and enables them to be read and reset without removing them from the support, thus minimizing the danger of breakage occasioned by frequent handling.

Weather-Instrument Shelter, Region 1 Type. (Index No. 467.)

The Region 1 instrument shelter is suitable for the exposure of fire-weather temperature

and humidity equipment only (fig. 2-7). Fuel-moisture-indicator stick scales, etc., can also be kept in the shelter. Its advantage over the Region 6 shelter and the standard Weather Bu-



FIGURE 2-7.—Region 1 type instrument shelter.

reau cotton region shelter is in its economy of materials and labor required for construction.

Weather-Instrument Shelter, Region 6 Type. (Index No. 468.)

The Region 6 instrument shelter is similar in size and general design to the Weather Bureau cotton region shelter (fig. 2-8). Specifications call for stock-size lumber as far as practical and a minimum of fitting is required in construction, thus reducing the cost. The shelter is built in sections, the door, roof, sides, back, and floor each forming one complete section. The completed sections are shipped painted, and are assembled on the ground. Shelters are furnished with hardware but with-

out legs. The shelter is suitable for hazard-indicator stick scales and temperature and humidity instruments.

Weather-Instrument Shelter, United States Weather Bureau Cotton Region Type. (Index No. 469.)

The Weather Bureau cotton region shelter is substantially built with louvered sides, back, and door, and is suitable for the exposure of meteorological instruments at headquarters stations and at stations maintained in cooperation with the Weather Bureau (fig. 2-9). This shelter is designed for the correct exposure and adequate protection of the instruments housed, rather than for economy in construction and is higher in cost than the Region 6 type for this reason. Its general use for seasonal observations at fire-danger stations is not recommended.

Wind Vane. (Index No. 477.)

The Region 6 wind vane is used at fire-danger stations to indicate the direction of the wind. It consists of a free-turning aluminum vane, a rigid steel support, and brass cross bars with brass letters designating the four cardinal directions. The vane is of improved, streamline design to reduce flutter in unsteady winds. Support for attaching vane to a pole is included.

Inflammability Station Lay-out Plans. (R1-X.)

Figures 2-18 to 2-22 provide plans for and describe the method of laying out forest inflammability stations. These plans were developed by Region 1 landscape architects and the Northern Rocky Mountain Forest and Range Experiment Station. If copies of these plans are desired they should be requested direct from Region 1.

Fire-Danger Record Forms. (R1-X.)

The use of standard forms for the recording of fire-danger information has not been uniformly adopted because of the newness of the field and because of the limited number of fire-control agencies actually rating fire danger on an extensive scale. For ready comparison of protection units on a regional basis, however, it is essential that uniform recording practice be maintained at least throughout the Region.

The forms illustrated on the following pages (figs. 2-10 to 2-15) have been devised by the Northern Rocky Mountain Region for fire-danger use and are offered as illustrating an orderly record-keeping system. In addition to these, Weather Bureau Form 1009-E, 10-day weather summary, is used extensively. It provides for daily records of weather factors and has blank columns which can be used advantageously for fuel moisture, visibility, etc.



FIGURE 2-8.—Region 6 type instrument shelter.

Fire-Weather Forecasting Trucks and Equipment. (U. S. Weather Bureau—X.)

The United States Weather Bureau has inaugurated a new series in connection with forest fire-control work throughout the northern and western Regions. The Bureau has constructed and placed in operation several completely equipped, mobile, meteorological units, radio-equipped, which are used to furnish fire-control forces with localized weather forecasts (fig. 2-16, 2-17). The units are operated in full cooperation with the Forest Service and the services rendered by them are of considerable value to protection and fire-control managers. A brief description of the type of unit employed follows:

Objects.—To provide, in effect, a traveling Weather Bureau office to proceed directly to going fires and render detailed and localized fire-weather forecast service to protection agencies. A secondary object is to provide a satisfactory means for establishing and inspecting

fire-weather observing stations, and to transport the necessary equipment.

General description.—Each mobile unit consists of a 1½-ton panel-body truck (131-inch wheelbase), suitably altered and fitted with radio, meteor-



FIGURE 2-9.—Weather Bureau cotton region instrument shelter.

ological, charting, and camping equipment. Each unit operates from a fixed base, the operating personnel (a meteorologist and an observer-radio operator) proceeding to fires when requested through the regional fire dispatcher, supplying daily forecasts through radio broadcasts and special forecasts as required. The unit secures data for preparation of detailed weather maps through coded weather broadcasts via NPG, Mare Island, Calif., and from numerous hourly broadcasts in voice from Department of Commerce Airways radio station. Supplementary information, when not otherwise available, is telegraphed to the unit from the Weather Bureau at San Francisco. Local meteorological observing stations are set up in the vicinity of fires, and close contact by the meteorologist with local conditions of topography, cover, fire situation, and weather permits of much more detailed and complete localization of forecasts for fire control than is possible by any other means.

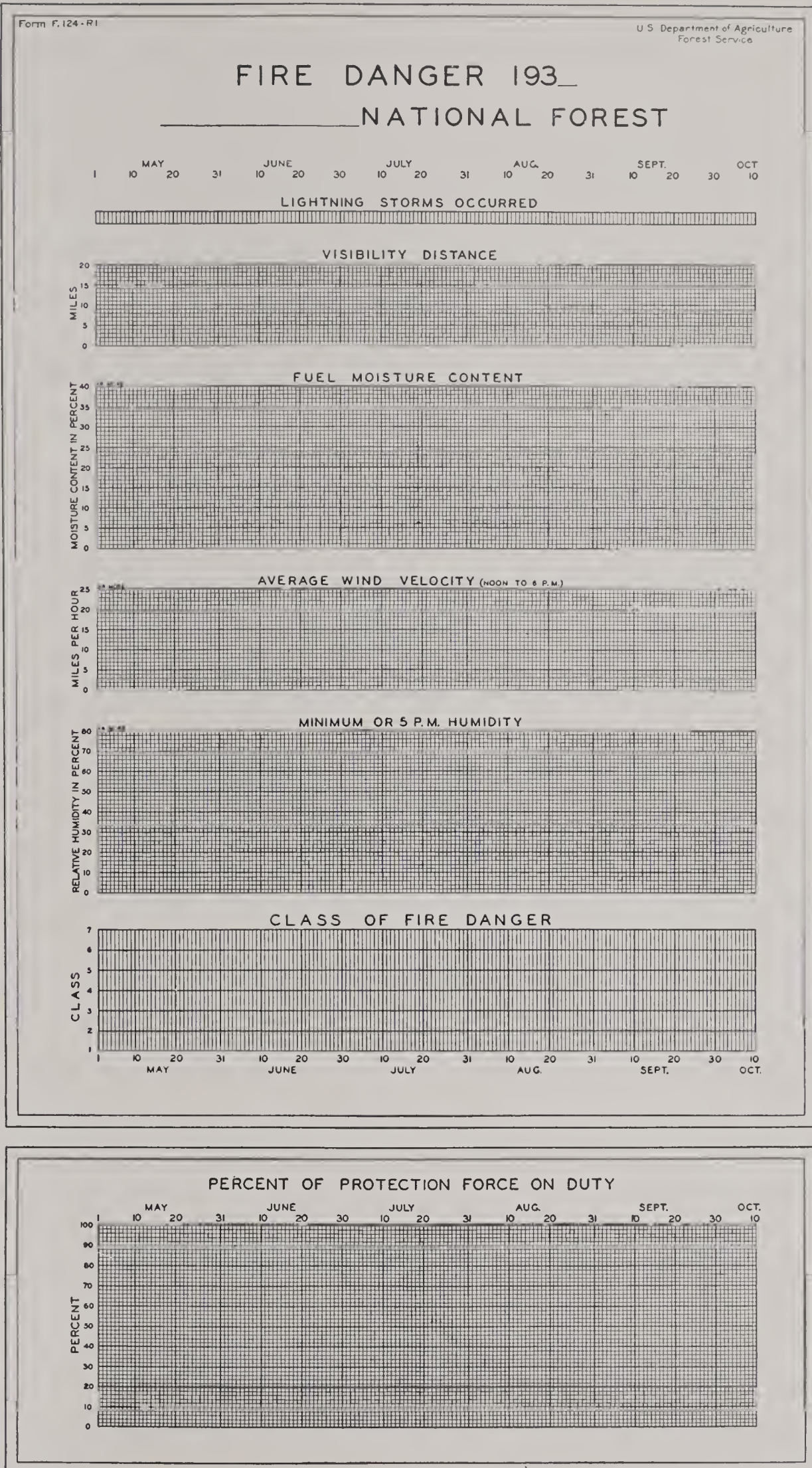


FIGURE 2-10.—Region 1 fire-danger chart.

Ferm 120-R. 1

U. S. DEPARTMENT OF AGRICULTURE
FOREST SERVICE

FIRE DANGER DAILY RECORD

(National Forest)

These data for the period $\left\{ \begin{array}{l} \text{beginning 6 p. m.} \frac{\quad}{(\text{Day})} \\ \text{ending 6 p. m.} \frac{\quad}{(\text{Day})} \end{array} \right\}$

(Month)

(Year)

[illegible]

Weather foreecast for this period:

FIGURE 2-11.—Daily fire-danger record.

LIGHTNING STORM OCCURRENCE RECORD

Year

[illegible]

FIGURE 2-12.—Lightning storm occurrence record. (Back of form same as front.)

Pf-2, B5
Form 1

WIND VELOCITY RECORD

_____ NATIONAL FOREST

193 ____.

WIND GAGE NO. _____

STATION NAME ELEVATION LOCATION: SEC. TWP. RANGE

DAY OF MONTH	MAY			JUNE			JULY			AUGUST			SEPTEMBER		
	10	3	5	10	3	5	10	3	5	10	3	5	10	3	5
	AM	PM	PM	AM	PM	PM	AM	PM	PM	AM	PM	PM	AM	PM	PM
1															
2															
3															
4															
5															
6															
7															
8															
9															
10															
AVERAGE															
11															
12															
13															
14															
15															
16															
17															
18															
19															
20															
AVERAGE															
21															
22															
23															
24															
25															
26															
27															
28															
29															
30															
31															
AVERAGE MONTH															

FIGURE 2-13.—Daily wind-velocity record. The visibility-distance recording form used by Region 1 is identical to this form except for heading and instructions for measuring.

Pf-2, B5
Form #2DETAILED RECORD OF WIND
(During Big Fires)

National Forest

Month _____, 193___. Station Name _____ Elevation _____ Sec. _____ Twp. _____ Range _____

Type of Anemometer Used _____

Day of Month	Hour of Measurement																			
	A.M.											P.M.								
	3	4	5	6	7	8	9	10	11	Noon		1	2	3	4	5	6	7	8	9
	Miles per Hour at Time of Measurement																			
1																				
2																				
3																				
4																				
5																				
6																				
7																				
8																				
9																				
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FIGURE 2-14.—Special wind records.

The truck bodies are divided by a lateral partition into two compartments. The forward compartment furnishes working space for radio operation, charting, and forecast preparation. A heavy shelf provides space for chart work, typewriter, and radio equipment, and lockers and cabinets built in furnish storage for stationery and miscellaneous items of equipment. The truck seats are moved to a fixed locker to serve the needs of the radio operator and meteorologist. A detachable charting board permits of attachment to the outside wall of the truck if this is desirable. A canvas tarpaulin shades one side of the truck, and personnel do outside work and sleep under this shelter. The rear compartment provides storage space for instrumental equipment, supplies, and tools for servicing fire-weather stations, generator for radio and lights, camping equipment and personal luggage, and extra tanks for water, gasoline, and oil. A roof luggage rack provides mounting for a sectional 25 foot radio mast and for an anemometer pole, and serves to carry a number of instrument shelters, supports, and rain gages when new sta-

tions are being established. An instrument shelter with complete equipment is attached to the inside of the left rear door so that when the door is locked in an open position the instruments are available for local observations.

Equipment.—The equipment consists of various truck accessories such as fire extinguisher, first-aid kit, spotlight, backing light, trouble light, flares, chains, etc.; camping equipment, including blankets, bed rolls, and tarpaulins with several coils of rope, steel tent stakes, and jointed wooden tent poles; meteorological equipment, including an instrument shelter, rain gage and support, barograph, hygromograph, maximum and minimum thermometers and support, psychrometers (hand-sling, fan, and rotor types), anemometer with buzzer and light-velocity indicators, forms, and miscellaneous extra instruments for establishing a limited number of temporary stations in the vicinity of fires; radio equipment, including a 700-watt generator, M-type transmitter and National HRO or Hammarlund Comet Pro receiver with speaker, key, headphones, and two antennae (Hertz single-wire feed for

DAILY RAINFALL RECORD										FOREST										MONTH										YEAR									
STATION NAME AND SECTION, TOWNSHIP AND RANGE																																							
MONTH																																							
DAY																																							
PRECIPITATION FOR PAST 24 HOURS. MEASURED AT 6:00 P.M. MOUNTAIN, OR 5:00 P.M. PACIFIC TIME																																							
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2																																							
3																																							
4																																							
5																																							
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30																																							
31																																							
TOTAL																																							

FIGURE 2-15.—Daily precipitation record. A part of this form, not shown in the above reproduction, is the following note: Be sure to show both the station name and location at the head of each column. For any amount of rain less than 0.01 inch use T, signifying trace. Use the letters MN to indicate periods when no measurements were made at each station. When the observer is absent from his station for a few days and the total rainfall is measured upon his return, show the total against a bracket for those days on which precipitation occurred.



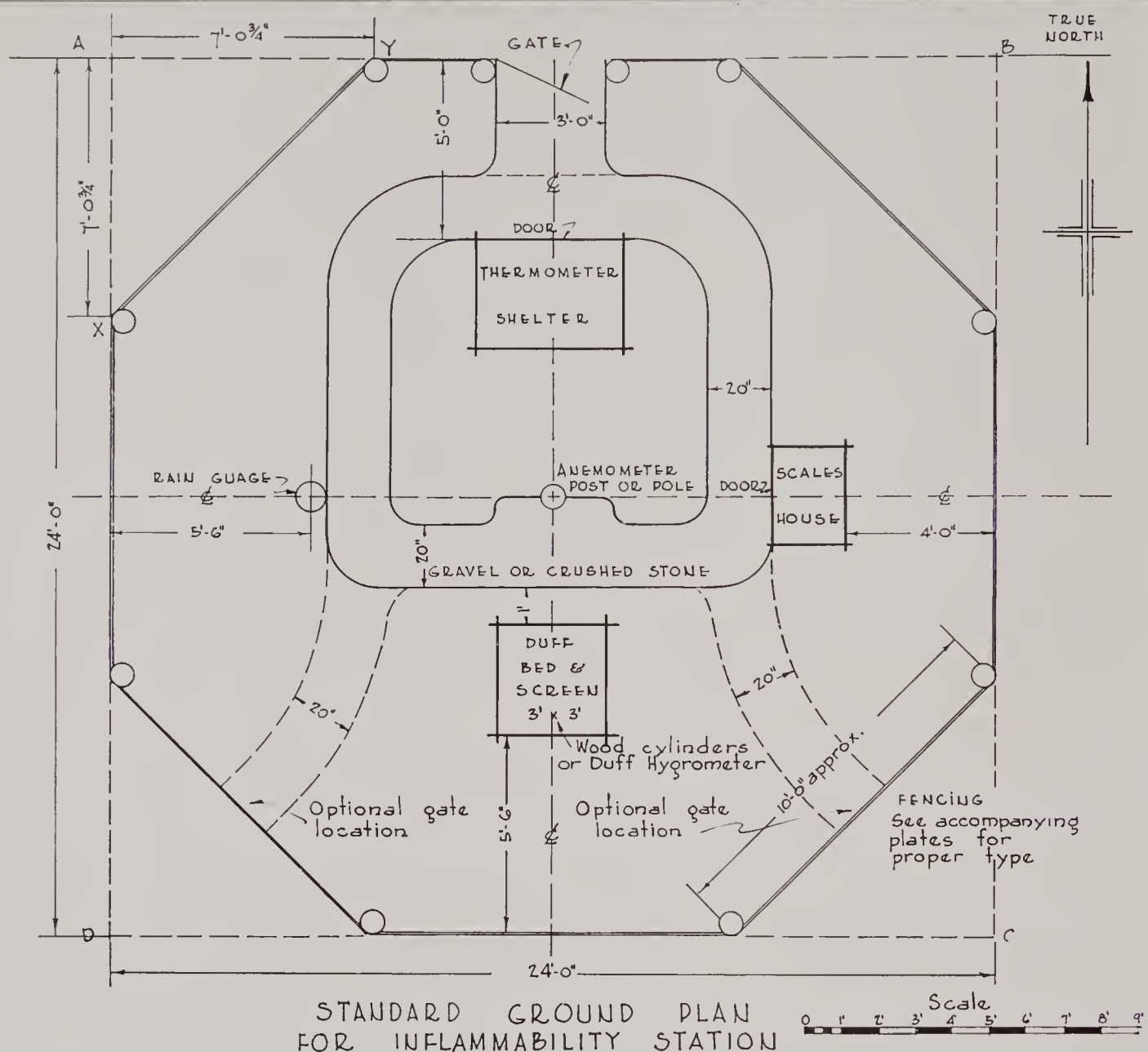
FIGURE 2-16.—Fire-weather forecasting truck.

transmitter; low-impedance, twisted-pair feed doublet for receiver); charts of several types for weather maps, with necessary stationery, a detachable charting board for outside use; and miscellaneous equipment, including shovel and ax, assorted tools for truck repair and station service work, three 12-gallon tanks fitted with outside filler spouts and inside drain cocks, mounted in a rear compartment inside the truck for extra gasoline, water, and oil, step plates to make access to the roof easy, an inside electrical switch panel (for both 6- and 110-volt current), including pilot lights, receptacles for plugging in soldering iron, radio, electric fan, etc., and master and individual switches for control of all appliances; special anemometer circuit for velocity determinations by sound or light; and several inside lights (both 6- and 110-volt) ready for night work. Maps of several kinds for all of the territory covered by each unit are always carried, and it is intended to supplement existing equipment with a radio set-tester and a humidity-temperature cabinet for testing hygrothermographs in the field.

Cost.—The cost of a completely equipped unit is as follows: Truck, \$920; alterations, \$350; camping and miscellaneous equipment, \$175; meteorological equipment, \$350; radio equipment, \$525; minor items, \$50; total, \$2,370.



FIGURE 2-17.—Rear-end view of fire-weather forecasting truck set up for operation.



When necessary to set station relatively close to Administrative Site, check proposed site with Regional Office before proceeding with construction, to insure against conflict with future development.

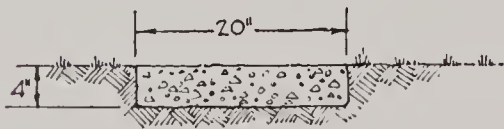


FIG. 2

WALK CONSTRUCTION DETAIL

Excavate soil to width and depth shown and refill with gravel or crushed rock level with existing soil. Use coarse material in bottom sifting finer material over surface for binding. Gravel or stone should be dark in color, avoiding light and glaring tones.

DIRECTIONS FOR LAYING
GROUND PLAN

Lay out 24' square marked A, B, C, D. From point A measure 7'-0 $\frac{3}{4}$ " along lines A-B and A-D respectively locating points X and Y. Repeat at points B, C, D until all corners are located.

All instrument structures are located with centers on either North and South or East and West axis and at distances shown from fence. Where size of instrument structures may vary, the walk should be adjusted accordingly, but following alignment shown. Instruments must be located and oriented as shown.

Area outside of fence for a distance of 20' in every direction must be free of structures and vegetation which will affect station in respect to wind, sunlight and rain. No irrigation or sprinkling is permitted within this area.

FIGURE 2-18.—Inflammability station standard ground plan.

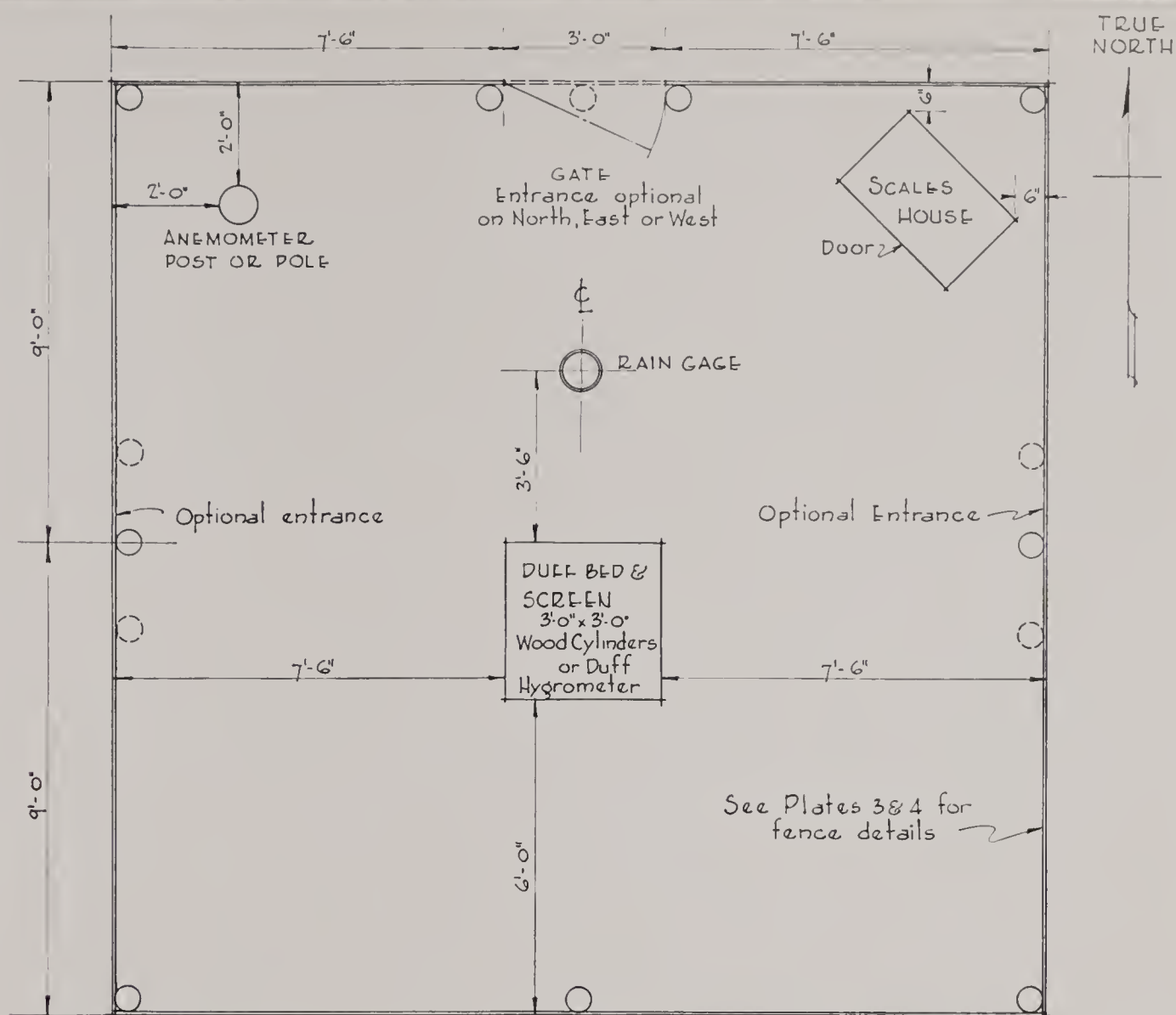
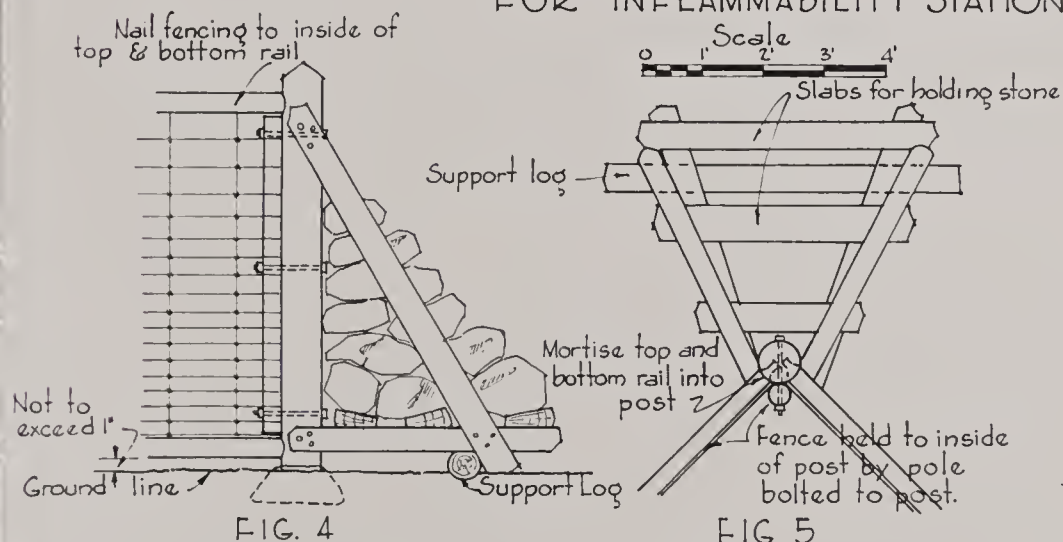


FIG. 3

MODIFIED GROUND PLAN FOR INFLAMMABILITY STATION

FIG. 4
SIDE ELEVATION
SHOWING STONES IN PLACEFIG. 5
PLAN VIEW
BEFORE STONES ARE ADDED

POST DETAIL

SHOWING METHOD OF SETTING POSTS
ON ROCKY SITES WHERE DEPTH OF SOIL IS NOT SUFFICIENT

INSTRUMENTS MUST BE LOCATED
AS SHOWN

Area outside of fence for a
distance of 20' in every di-
rection must be free of struc-
tures and vegetation which will
affect the station in respect
to wind, sunlight and rain. No
irrigation or sprinkling is
permitted within this area.

NOTE: THIS SAME PRINCIPLE
MAY BE APPLIED TO SUPPORTS
FOR INSTRUMENTS UNDER
SIMILAR CONDITIONS

FIGURE 2-19.—Inflammability station modified ground plan and post detail.

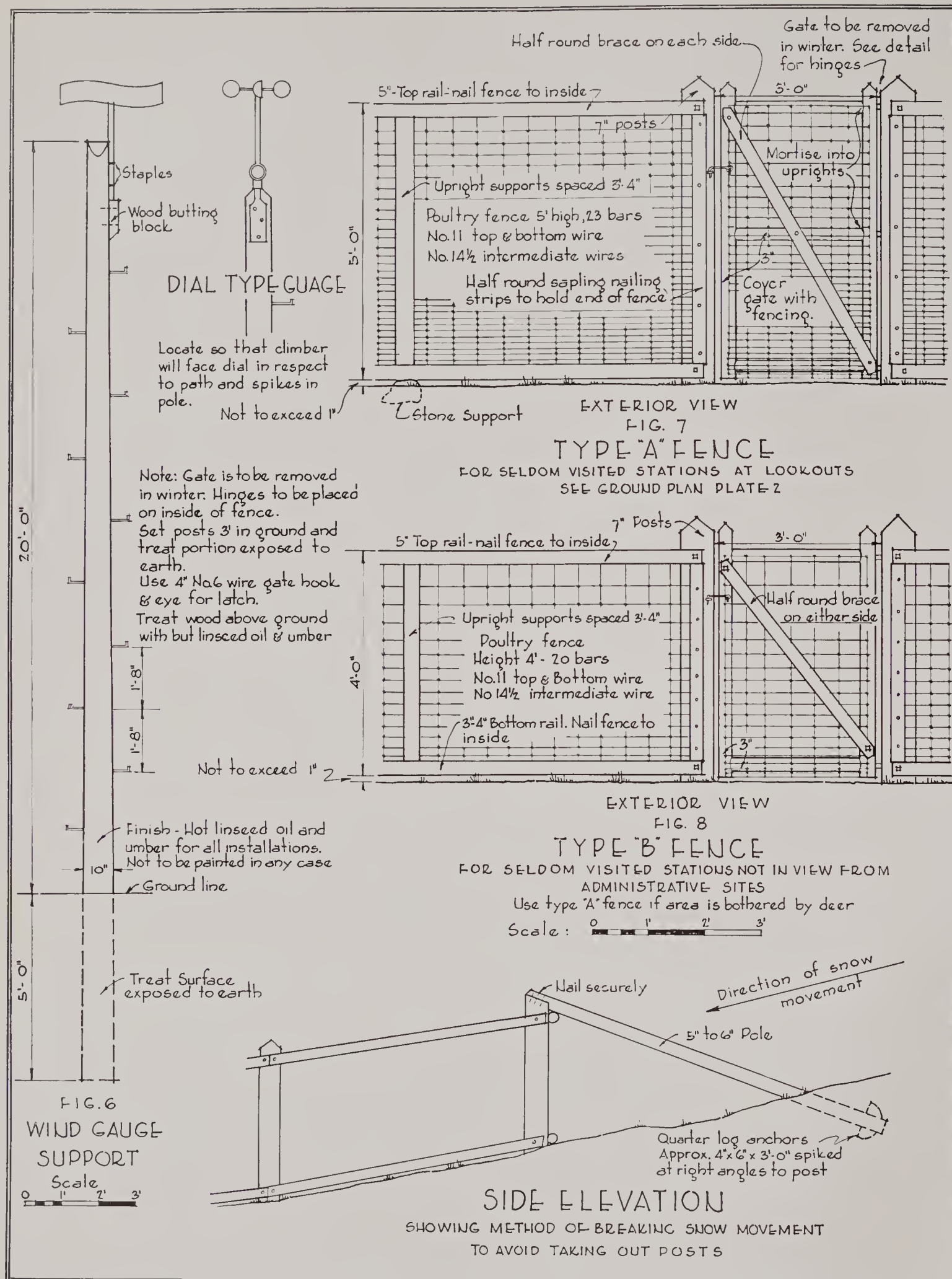
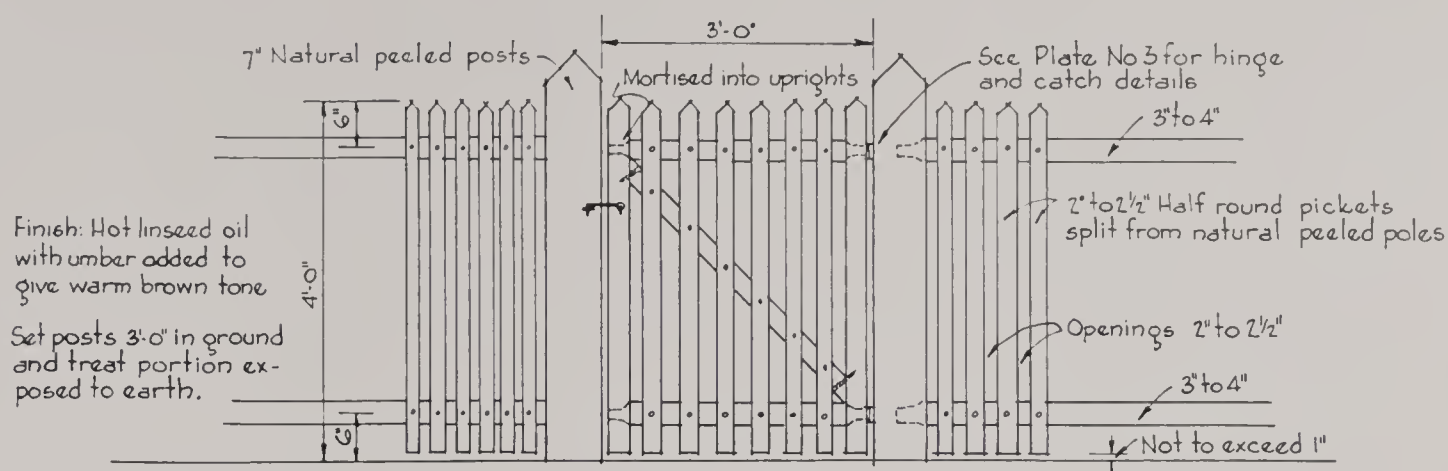


FIGURE 2-20.—Standard fence and gate details and standard wind-gauge support for inflammability stations.



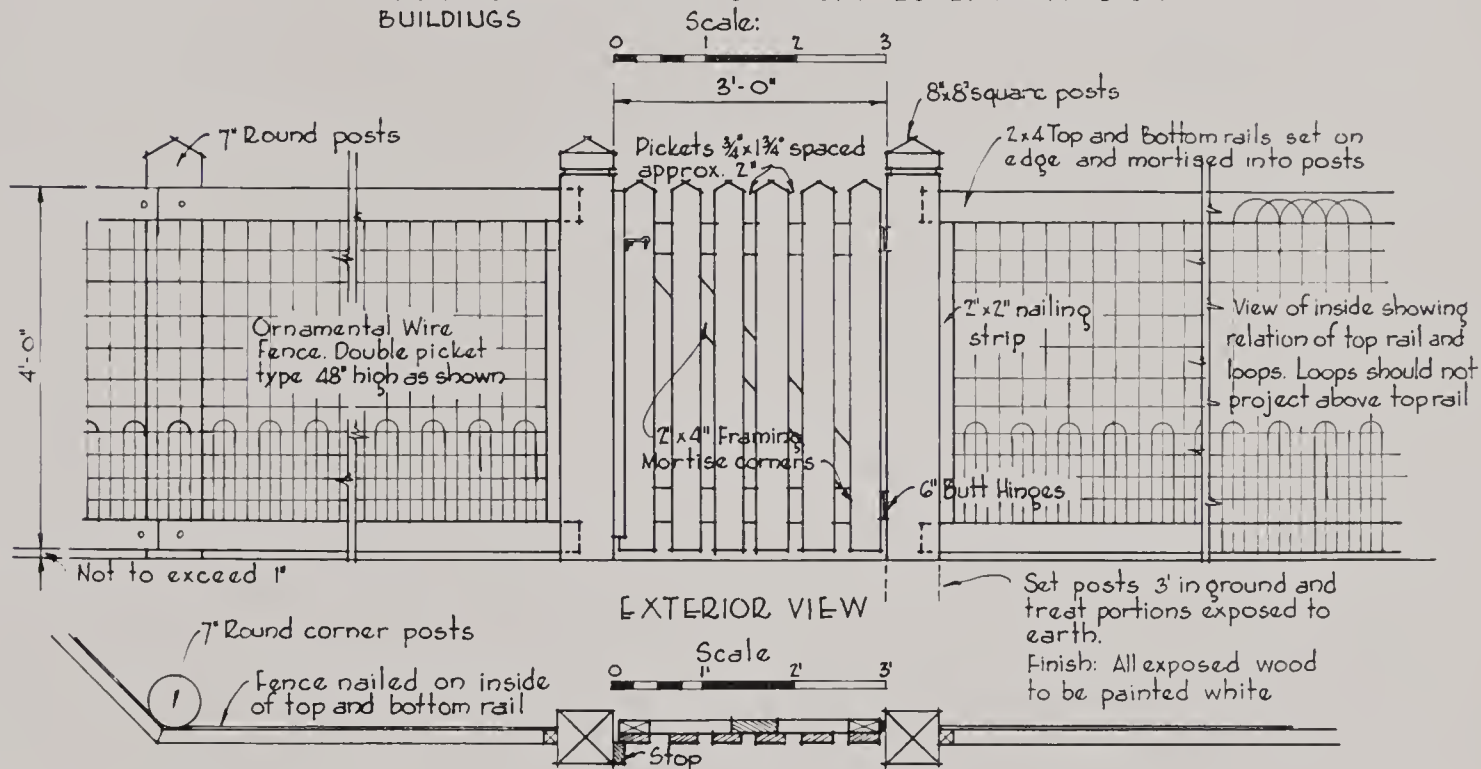
SEE GROUND PLAN PLATE I

EXTERIOR VIEW

FIG 10.

TYPE "C" FENCE

FOR FREQUENTLY VISITED STATIONS IN NATURAL SETTING OR WHEN LOCATED SO AS TO BE VISIBLE FROM ADMINISTRATIVE SITE HAVING LOG OR STAINED EXTERIORS ON BUILDINGS



SEE GROUND PLAN PLATE I.

PLAN SECTION

FIG. 11

TYPE "D" FENCE

FOR FREQUENTLY VISITED STATIONS WHEN LOCATED NEAR OR AS AN INTEGRAL PART OF AN ADMINISTRATIVE SITE HAVING WHITE EXTERIOR ON BUILDINGS

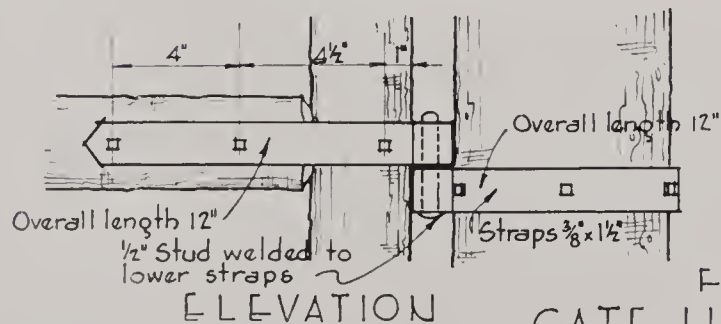


FIG. 12

GATE HINGE DETAIL

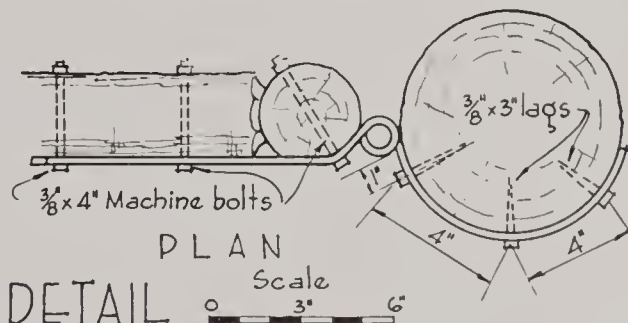
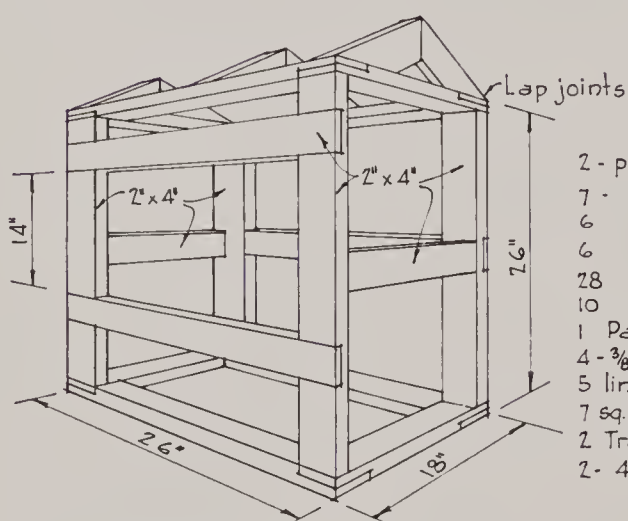
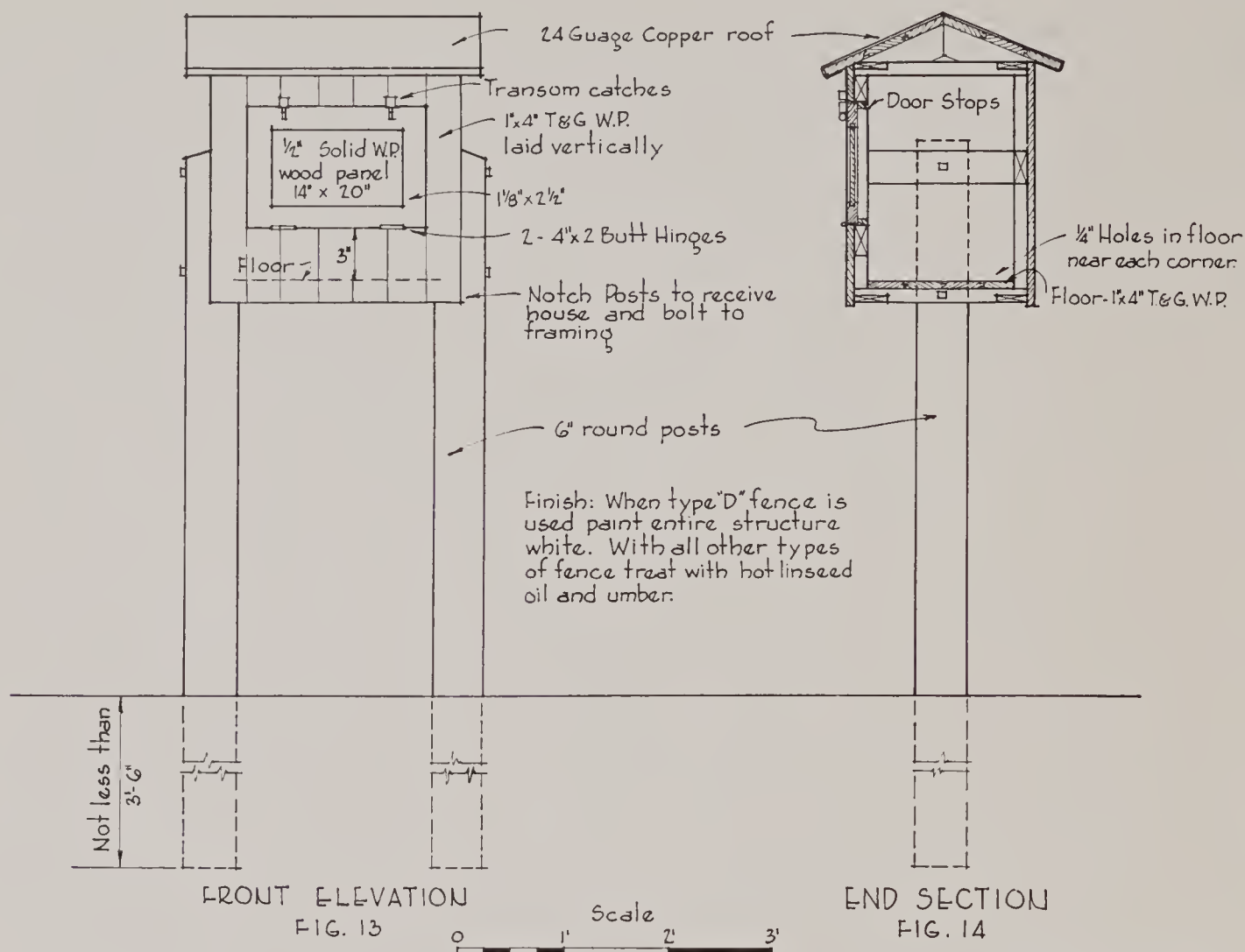


FIGURE 2-21.—Standard fence and gate details for inflammability stations.

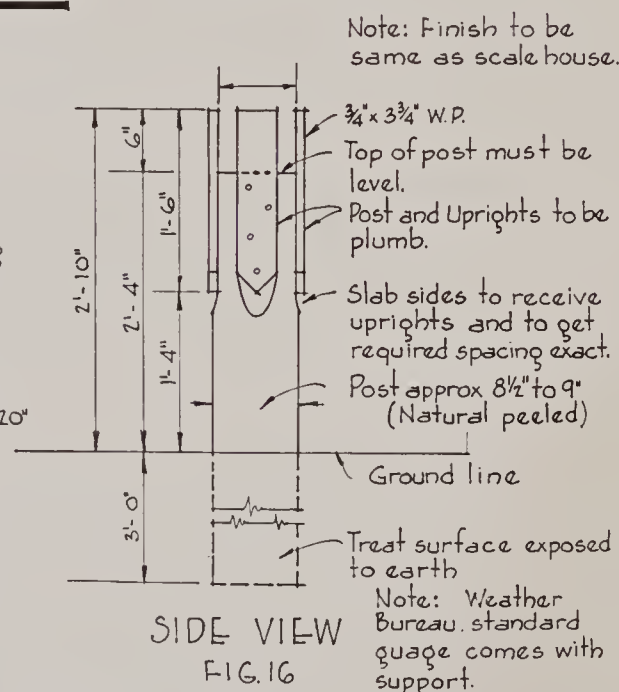


FRAMING DETAIL
FIG. 15

STANDARD SCALE
HOUSE
No Scale

MATERIAL LIST

- 2- pcs 6"x6" - 10'-0" long
- 7- " 2"x4" - 2'-2" "
- 6- " " 1'-6" "
- 6- " " 1'-0" "
- 28- " 1x4 T.G. W.P. 2'-2" "
- 10- " " " 2'-10" "
- 1 Panel door as shown 14"x20"
- 4- 3/8"x6" Machine bolts
- 5 lin. ft. 1/2"x3/4" door stop
- 7 sq. ft. 24 gauge copper.
- 2 Transom catches
- 2- 4"x2" Butt Hinges.



DETAIL OF RAIN GAUGE
SUPPORT FOR STANDARD
FOREST SERVICE GAUGE

FIGURE 2-22.—Standard scale house and standard rain-gauge support for inflammability stations.

PART THREE
MISCELLANEOUS INFORMATION

PART THREE

MISCELLANEOUS INFORMATION

Fire-Prevention Equipment and Information.

Motorcycle patrol.—Figure 3-1 portrays quite clearly suitable types of equipment for forest-fire motor patrolmen. The patrolman is



FIGURE 3-1.—Motorcycle fire patrolman contacting a camper and instructing him in the proper method of caring for his campfire.

outfitted with the appropriate type of uniform clothing and the forestguard badge. The motorcycle is equipped with shield-shaped forest-fire patrol insignia and is also equipped with lightweight suppression tools. In some instances it is also desirable to furnish a portable telephone as standard equipment with this type of patrol.

In addition to the suppression equipment, etc., that he carries, the patrolman also has appropriate forms for recording conditions of campfires, campgrounds, etc., and where campfires are permitted only with written permits, he is equipped to issue these as well.

Tourist registration desk.—Region 5 has employed rather successfully a unique way of obtaining the cooperation of tourists and campers in refraining from defacing signs, damaging trees, and littering campgrounds unnecessarily. The scheme used is to illustrate actually and photographically defaced Forest Service signs, damaged shade trees, and littered campgrounds. An example sign and appropriate photographs are displayed beneath the glass top of the conventional type of registration desk (figs. 3-2, 3-3).

In describing the desk and its use still further, Region 5 offers the following information:

This desk is used as a registration desk in the issuance of campfire permits. It has its greatest use at guard stations, where there is no office and is usually located on the front porch of the station.

When anyone asks for a fire permit, map, or fire-prevention literature, he is asked to step over to the registration desk. The display immediately attracts his attention, giving the forest officer or guard an opening for a fire-prevention contact.

The desk is fastened to the wall and has a hinged top which lifts up, leaving underneath a compartment in which is kept the necessary registration and other forms.

Over the desk is placed a shielded electric light for night work. Under the plate-glass top are the pictures, etc., fastened to a Forest Service large-sized green desk blotter. This color seems to make the display stand out. The two Forest Service shields and the words "Prevent fires" are cut out of a standard 7- by 14-inch yellow-paper fire sign.

Looking at figure 3-2, the left-hand picture is of a tree in one of the campgrounds that



FIGURE 3-2.—A close-up view of the glass-topped registration desk with fire signs and photographs mounted beneath the glass.



FIGURE 3-3.—Region 5—tourists' and campers' registration desk.

has been "carved up" by the public and is dying. A caption over it reads: "Dying from knife wounds." The center picture shows an actual garbage can on a campground. It is overflowing with paper and paper is thrown around the base. It brings out the point that people, instead of following directions printed in the rules of the campgrounds to burn in the campground stoves all inflammable materials, simply throw them into the garbage can. The right-hand picture shows a tree badly carved and a caption over it reads: "Don't carve trees." The upper photo, center, is a photograph of a 7-by-14 fire sign that had been posted in an area where campfires are prohibited. It brings out the point of sign defacement by the public by writing names, wisecracks, etc., on the signs. It has a caption over it reading: "Don't mutilate signs."

There is one point in connection with this display that is pertinent. The public will look at a photo, whereas printed rules do not attract them. Pictures usually lead to inquiry as to how anyone could do such things, etc., and give the forest officer or guard an opportunity to do a little missionary work.

Preparing Supplies and Equipment for Dropping From Airplanes.

Transportation of fire-control equipment and supplies is still a major problem in many forested areas. In recent years aerial transportation has served to materially lessen the acuteness of this situation. As time goes on and as technique is developed, the airplane will become more and more a fixed part of the fire-control scheme. In order that others may make use of this method of transportation to the extent of possibilities discovered to date, the following information is offered:

There are three distinctly different methods described—the excelsior-packing method, the loose-packaging method, and the parachute method, developed (insofar as development work has progressed) by Regions 1, 4, and 6, respectively. Undoubtedly this particular phase

of fire-control work will have reached a more definite stage of development by the time the first amendments to this handbook are made.

(1) *Excelsior and tight-packing method.*—Methods adopted by Region 1 for preparing and dropping fire-fighting supplies and equipment from airplanes are covered by the following descriptive data:

Size and weight limits.—Bundles must not exceed sizes that can be passed readily through the door of the ship employed. Region 1 specifications are "Not to exceed 22 inches in diameter." The doors

of the ships used in Region 1 have a width of not less than 28 inches. Lengths of bundles are governed by—

1. Convenience in loading and handling within the ship.
2. Difficulty in rolling long bundles out while ship is in air.
3. Desirability of getting the most materials delivered in each dropping operation.
4. Size of some tools—saws, for example.

Length of bundles should be kept within 5 feet except in case of tools which are more than 5 feet in length. Bundles land best when length and diameter are about equal; but this consideration must be balanced against the desirability of dropping as much as possible in each bundle, particularly when a large load is being handled. Since diameter is definitely limited, additional weight per bundle can be obtained only by increasing the length.

Weight is limited by—

1. What can be packed within the size limits.
2. What can be handled conveniently by the man doing the dropping (the dropper).

The more uniform bundles can be made in size and weight, the closer the dropper can come to the target.

The use of open ships for dropping bundles should be avoided if possible. It is too dangerous.

The foregoing specifications are based on 4-, 6-, and 12-place cabin ships. (Doors should always be removed before flight.) If possible, the ships to be used should be investigated before bundles are wrapped.

In Region 1, the pilot gives the dropper the word to let go. The dropper is not able to see the target.

Outside covering and roping of bundles.—Fourteen-ounce canvas should be used for wrapping tool bundles. When both kapok beds and tools are to be dropped, tools should be rolled into the beds and canvas should be used for the outer bundle cover. Edged tools should be provided with suitable sheathing. For food supplies, canvas as light as 10 ounces

may be used. Weak or rotten canvas should not be relied upon. It will tear too easily.

Region 1 uses 6- by 7-foot canvas for both tools and food. About these dimensions are necessary for full-sized bundles. White canvas is preferred so that bundles can be more readily found. In roping the bundles, use $\frac{1}{4}$ -inch rope. Bundles should be roped snugly, using a weblike hitch, with ropes about 12 inches apart. Rigidity of bundles is necessary for convenience of handling in the plane. Care should be taken to see that no loops or loose ends are left hanging. They might catch the hand of the dropper or a projection near the door of the plane.

Inside wrapping and packing of bundles.—In assembling bundles, the canvas is first spread out. The fluffiest grade of long-fiber wood excelsior (not shredded paper) should be used. Shake out the excelsior and spread enough of it on the canvas so that there is a 3-inch layer of excelsior between the canvas and the goods to be transported *after* the goods rest on the excelsior.

In packing tools, lay them diagonally with respect to the canvas. Lay the tools so that there will be not less than 1 inch between items. This space will be pressed full of excelsior in subsequent steps. On this first layer of tools, spread two-thirds as much excelsior as used under the layer of tools. Then place the second layer of tools, separated as before. Over this, spread excelsior the same as on the first layer of tools. Continue the process until the size limit of bundle is reached.

On top of the last layer of tools place a layer of excelsior equal to that *under* the first layer of tools.

Fold in the canvas over the ends of the tools, placing at the ends of the tool pack an amount of excelsior equal to that under the first layer of tools. Then fold in the canvas from the sides, making sure that there is excelsior between canvas and tools as before. All folds of canvas should be drawn as tightly as possible to prevent wrinkling when roping.

When kapok beds are to be transported, they may be substituted for part of the exterior layer of excelsior with the bed placed next the canvas. Care must be taken to see that the beds are protected by excelsior from damage by the tools.

If beds are to be dropped separately, they only need be roped into appropriate sized bundles. No canvas covering is necessary, although it can be used.

Saws represent a special problem. The best practice has not been definitely determined. The following method has been used successfully in a few instances:

Drop two saws in a bundle. (Two or three bundles of saws can be thrown out at a time.)

Sheath each saw separately in split hose. Place the saws together with sheathed edges opposite each other. Lay both saws on a $\frac{3}{4}$ -inch board 8 inches longer than the saws and 2 inches wider. On top of saws place a $\frac{1}{4}$ -inch board of same length and width as first board. Bolt saws to both boards through handle holes at each end, using stove bolt with wing nut (so nut can be unscrewed without a tool). Wrap outsides of boards with wire in four places leaving enough ends on wires so that it can be removed without a tool. This bundle should be wrapped with excelsior and canvas as previously described.

In wrapping first-aid kits for dropping, the bottles should be separated from each other with corrugated paper. The kit should be placed well in the center of some suitable bundle.

In packaging food supplies, as a rough guide, about 25 to 30 percent of the gross weight of a bundle should consist of excelsior, canvas, and rope.

Put cans of No. 2 size or smaller end to end to about 14 inches. Wrap each 14-inch roll tightly in ordinary wrapping paper and seal with gummed paper tape. Canned foodstuffs such as cheese, brown bread, coffee, fruit in 8-ounce cans, and items of a similar nature require no excelsior or other packing between the ends of the cans in the 14-inch rolls. Canned foodstuffs, such as canned meats (in not to exceed 2-pound cans), butter (in not to exceed 1-pound cans), jam, milk, pickles (over 10-ounce size), and items of a similar nature require about an inch of compressed excelsior between the ends of the cans in the 14-inch roll. The excelsior should be fluffed out before being compressed.

Rolls of cans should be placed at right angles to the long way of the bundle, with each roll separated from all other rolls by 2 to 3 inches of compressed excelsior.

The thickness of excelsior between the canvas and the outside of the bundle of rolls should be the same as previously specified for bundles of tools, except that on the ends of food bundles there should be 8 to 10 inches of compressed excelsior. Canvas should be wrapped tightly and bundles should be roped as specified for tool bundles. For method of making up can rolls and of placing rolls in the excelsior bundle see fig. F-5.

In arranging food bundles, those items most susceptible to breakage should be placed in the center.

The larger the can or the more weight contained therein, the more susceptible they are to breakage. Cans larger than No. 2 size containing either liquids, heavy solids, potatoes, or bakers' bread, cannot be dropped successfully without excessive padding. Canned

brown bread, packaged zwieback, etc., must be used in lieu of bakers' bread.

Dried beans, dried fruit, rice, sugar, coffee, oatmeal, etc., in lightweight canvas bags, half filled and securely tied, and bacon, chocolate, etc., can, of course, be dropped without difficulty. Fresh meat should be dropped in chunks not exceeding 15 pounds in weight. All such items should be packed as other food supplies—so that 25 to 30 percent of the gross weight of a bundle is made up of excelsior, canvas, and rope.

Cooking utensils are difficult to drop successfully. Cooking vessels must be seamless or they will be opened at the seams by the impact.

Each bundle should be tagged to indicate the items contained therein to facilitate opening the right package when in search of some item. Invoices listing the bundles and their contents may be dropped in a message dropper consisting of a canvas bag containing 1 pound of sand to which is attached a red and white streamer 2½ inches wide by 6 feet long.

When dropping bundles, they should be given a quick, downward shove to avoid danger of fouling the rear of the plane. Under some circumstances two to four bundles can be put out at a time, thus reducing the number of return flights over the marker.

Bundles packed and dropped by this method will not hang up in trees. In fact, it is desirable to drop them into dense brush or young growth if possible, as it breaks the fall materially. There is little or no danger of becoming fouled in loose lines or of chutes becoming tangled. The original packaging constitutes practically the entire job, and this can be done in advance. Another advantage of this method is that from two to four bundles can be discharged at one time with safety.

The use of streamers has been found unnecessary with this method. The only requirements are that the outer wrapping of bundles be white so that they may be seen readily and that a ground man be on watch. In all of the aerial deliveries made to date, by this method, Region 1 has had no losses.

As a rough guide in packaging foodstuff for aerial delivery, the following items are listed in their respective order of susceptibility to breakage and loss of food value:

- | | | |
|-------------------|---|----------------------|
| Most susceptible | { | 1. Ham, canned. |
| | | 2. Butter, canned. |
| | | 3. Milk. |
| | | 4. Jam. |
| | | 5. Pickles. |
| | | 6. Fruit cake. |
| Least susceptible | { | 7. Sugar. |
| | | 8. Fruit (8 ounces). |
| | | 9. Zwieback. |
| | | 10. Brown bread. |
| | | 11. Coffee. |
| | | 12. Cheese. |

(2) *Loose-packaging method.*—Region 4, which has pioneered the loose-packaging method for preparing fire-control tools and rations for aerial delivery, offers the following reports on results of several tests conducted in connection with this particular phase of fire-control work:

The loose-packaging method consists of wrapping the various items loosely in suitable



FIGURE 3-4.—Loose package with mail-sack container.

outside containers and tying securely at the top (fig. 3-4). For example, such items as bacon, ham, sugar, beans, raisins, dried fruits, canned goods, etc., are placed in individual cloth containers and tied loosely and then the lot to be dropped is placed within a large container, which is also tied loosely but securely at the top. Tools are dropped several at a time with streamers attached to each, but otherwise not secured to one another.

The success of this method of aerial delivery depends, of course, entirely upon the altitude from which the items can be dropped and upon the ground condition where they are to land. As has been stated in connection with the tight-package excelsior method advocated by Region 1, the most desirable location to drop items packaged by this method is in brush or light, young growth so that the fall is broken just before the articles strike the ground. A brief summary of 11 different tests, together with illustrations, follows:

TEST No. 1

Principal container: Mail sack, tied tightly at top.
Contents: 6 pounds bacon in 25-pound, misprint bag, tied loosely.

5 pounds pancake flour in 25-pound misprint bag, tied loosely.

5 pounds sugar in 25-pound bag, tied loosely.

5 pounds beans, dry, in 25-pound bag, tied loosely.

4 packages raisins, dry, in 25-pound bag, tied loosely.

5 packages fruit, evaporated, in 25-pound bag, tied loosely;

7 1-pound cans brown bread	} Thrown loosely in principal container containing six small sacks.
6 4-ounce vienna sausage	
6 $\frac{1}{4}$ s sardines	
6 8-ounce pork and beans	
1 No. 2 corn	
1 No. 2 string beans	
3 8-ounce jam	
1 tall milk	

Total weight: 57 pounds.

Drop: 375 feet, to hard-packed soil on 30-percent slope.

Damage: 1 can corn and 1 can pork and beans were burst and of no value.

2 cans brown bread, punctured but with 100-percent salvage value.

Principal container sustained a 2-inch rent. All other items in perfect condition.

TEST No. 2

Principal container: Mail sack tied tightly at top.

Contents: 10 emergency rations (R-1), weight approximately 5 pounds each, placed at random in container.

Total weight: 53 pounds.

Drop: 275 feet on hard-packed, rocky field.

Damage: 4 8-ounce cans grapefruit } Damaged beyond use.

3 2-ounce cans coffee } use.

2 1-pound cans brown bread } Broken but fit for use.

1 8-ounce can hash } for use.

Principal container sustained 12-inch rent.

TEST No. 3

Principal container: 3 mail sacks tied together at top.
Contents: 15 emergency rations, five to each bag as in test No. 2.

Total weight: 84 pounds.

Drop: 300 feet to hard-packed field.

Damage: Emergency ration sacks torn slightly.

1 8-ounce can pork and beans	} Damaged: no value.
3 8-ounce cans grapefruit	
2 2-ounce cans coffee	

All other items, including principal containers, undamaged.

TEST No. 4

Principal container: Mail sack lined with 11 pounds of excelsior.

Contents: Improvised mess outfit for 20 men, containing—

2 kettles, aluminum No. 883.

20 tin plates.

2 pans, frying, large.

4 pans, dish-up, large.

20 tin cups.

20 table forks.

20 table knives.

25 dessert spoons.

3 tablespoons.

2 can openers.

1 dish towel.

1 soap, laundry.

1 knife, butcher.

1 lifter, pot.

Plates, cups, and dish-up pans were nested in the two kettles. Forks, knives, and spoons were tied in separate bundles and the butcher knife was covered with a sheath. Kettles were placed bottom to bottom and smaller items distributed through the packing material.

Weight: Mess equipment 26 pounds, filler 11 pounds, container 3 pounds, total 40 pounds.

Drop: 300 feet to hard-packed, rocky field.

Damage: None, except slight bending of kettles, frying pans, and dish-up pans—all 100-percent servicable.

TEST No. 5

Principal container: Pack cover tied tightly with $\frac{1}{4}$ -inch rope. Small articles in knapsack rolled in kapok bed with shovel and Pulaski.

Contents: 1 complete smoke-chaser's outfit containing—

1 kapok bed.

1 baby shovel.

1 Pulaski.

1 knapsack.

1 headlight with 3 extra batteries.

1 bag, water, 2-gallon.

1 file, 10-inch.

1 stone, ax.

1 emergency ration (R-1).

Weight: 35 pounds. Drop: 375 feet to hard-packed, dirt road.

Damage: Pulaski and shovel unfit for service. Lens in light and two batteries broken—light still serviceable. Other items in perfect condition. This test must be termed a complete failure as suppression tools were broken.

TEST No. 6

Principal container: Canvas pack cover tied securely.

Contents: 3 Pulaskis with hose sheath, in one pack.

4 baby shovels in one pack.

Drop: 300 feet to hard-packed field—both packages simultaneously.

Damage: Shovels slightly bent but entirely serviceable. No damage to Pulaskis.

TEST No. 7

Four baby shovels thrown loose, without cover or ties, except for white cloth streamers, from 200 feet altitude to hard-packed soil. No damage.

TEST No. 8

Three Pulaskis thrown as in test No. 6. No covering or ties except hose sheaths on blades, but white cloth streamers 3 inches by 5 feet were tied to each. No damage.

Tools in tests 7 and 8 fell slowly with a spiral motion and did not scatter to any extent.

TEST No. 9

Principal container: Mail bag without filler.

Contents: One-half of a 25-man back-pack standard outfit (R-4) attached to parachute (28 feet—capacity 130 pounds) with $\frac{3}{8}$ -inch rope.

Contained—

10 baby shovels. 1 pump, hand.

12 Pulaskis. 7 knapsacks.

2 axes, double-bit. 7 rations (R-1).

13 hand towels. 7 headlights.

42 batteries, headlight. 1 individual first-aid kit.

2 files, 10-inch. 5 bars soap.

Weight: 198 pounds.

Drop: 200 feet.

Damage: None.

TEST No. 10

Principal container: Mail sack, tied tightly at top.

Contents: 4 pounds rice in flour sack, tied loosely.

4 pounds beans in flour sack, tied loosely.

1 pound box raisins in 5-pound cloth sack.

1 5-pound box dried fruit in 10-pound cloth sack.

3 pounds rolled oats in original paper sack placed in 9-pound sugar sack.

1 can corn

1 can veal loaf

2 cans Vienna sausage

2 cans sardines.

placed loosely in
burlap sack.

Total weight: 28 pounds.

Drop: 300 feet to meadow grass field.

Damage: None, except slight bending of some cans.

TEST No. 11

The same articles as in test No. 10 were resacked, plus one emergency ration, and dropped from approximately same height to a well-packed, gravelly field. Total weight: 33 pounds.

Damage: One can grapefruit and one can hash broken open, the latter being suitable for immediate consumption. Principal container sustained 6-inch rent. Other cans more bent than in first drop, but none admitting air.

(3) *Parachute method*.—Region 6 undertook to carry out tests after Regions 1 and 4 had completed some pioneering work, with a view to ascertaining if other items than those already tried could be dropped successfully, if larger quantities could be dropped, and in general, if a better method of dropping could be developed. These tests were carried out during the month of October at Pearson Field, Vancouver, Wash., using a seven-place Travelair cabin plane. Field tests were also carried out in dense woods near Vancouver. All these tests were made at sea level, but further field tests are being made at higher altitudes in order to make sure that the results are applicable to ordinary field conditions.

The tests were successful and developed the fact that it is possible to drop every sort of supplies and equipment in substantial quantities with sufficient accuracy to be readily found by the ground crew, and to do so without material loss or damage to either supplies, equipment, or containers.

The idea followed up was to retard the speed of the load, and in some instances to pack the articles so that there would be no impact from other articles placed on top of them. Various retarding surfaces were tried out, each possessing some advantages. All these devices, except for very light items which are best dropped in a loose sack, with or without another loose sack or two trailing behind, pointed to the wool-sack chute as providing the best combination of desirable properties in the way of efficiency, compactness, strength, low cost, ease of making,

ease of discharging, uniformity of drift, and ease of recovery.

The selected wool-sack chute is made of a burlap wool sack, opened up and tied in the four corners to shrouds 17 feet long. A wool sack was selected because such sacks are cheap and can generally be obtained in all small towns near the western national forests. When opened up, the sack forms a sheet of suitable size. Burlap by the yard or gunny sacks split open and sewed together so as to form approximately a 7- by 7-foot sheet would serve the purpose as well. This chute will lower 100 pounds of some items, compares in efficiency per square foot with other chutes—such chutes, for instance, as are used by the Army—can be made in less than 5 minutes, costs about 40 cents, and may be used repeatedly.

The loads dropped consisted almost 100 percent of supplies, the packaging material used being negligible both in weight and bulk. Since the loads are so compact, it is possible to load the airplane to its full-load capacity, leaving only a small space for the dropper. Following is a description of airplane chute method of packing various items, the pilot's and the dropper's business, etc., with diagrams:

The airplane should be a high-wing cabin monoplane with the door preferably, but not necessarily, back of the wing struts. The door should be removed. All chairs, except the pilot's seat, should also be removed.

The chute, as illustrated by figure 3-5, should be made from a wool sack. The seam along one side is opened by untying the thread at the end which frees the thread and opens the entire seam. The sack is cut at the bottom and spread

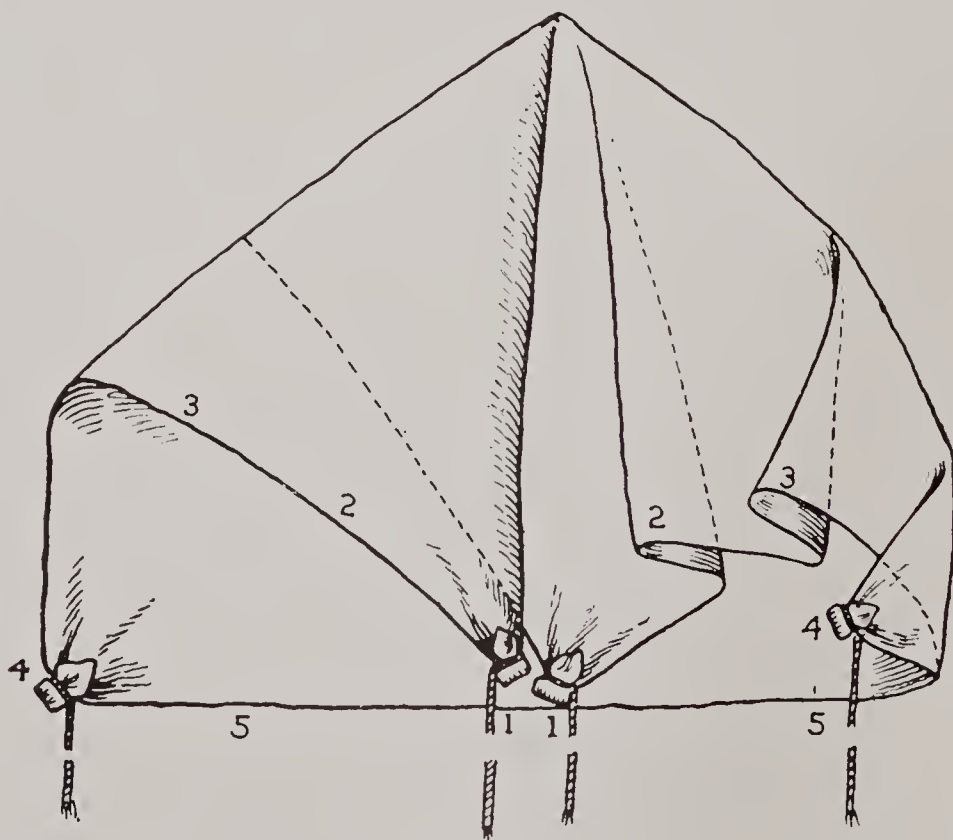


FIGURE 3-5.—Bring corners marked "1" together. Pick up corners at points 2, 3, 4, and 5 and fold as indicated.

out. It then forms a sheet about $6\frac{1}{2}$ by $7\frac{1}{4}$ feet, containing close to 50 square feet.

The shrouds are made preferably of clothes-line or sash cord, each shroud 17 feet long, and tied with a slipknot around the corner, which is folded single over a short stick of wood about 2 inches long. No corner made in this way ever tore. The shrouds are tied together about 1 to 2 feet from the end, the remaining foot or two being used for tying loads. If the shrouds are made of twisted material, they have a tendency to tangle up, especially if new rope is used. If rope is used, the size should be about one-fourth inch.

In order to be able to spot the load easier a chrome-yellow streamer is firmly attached to the top of the chute with blanket pins, or it may be sewed on with a sack needle through two or three thicknesses. The streamer should be from 4 to 6 inches wide and from 30 to 50 yards long, and should be made out of material easily ripped into ribbons. A good material is percale or cambric. The cost is from 10 to 19 cents a yard as sold by the bolt. One bolt will make several streamers. Where a band saw is available, the bolt is readily cut into streamers already rolled up and ready to use. Note that one cut will make two streamers rolled up together, since the fabric in the bolt is folded once. The bolt can probably be cut with a fine-tooth hand saw also, if placed between two boards. It saves work to use the bolt as it comes rather than ripping the cloth into ribbons, each of which would then have to be rolled up by hand. In open country a shorter streamer would be satisfactory, or the streamer could be dispensed with entirely. In heavy timber and underbrush, a long streamer is necessary, and the bolt of material as purchased contains just about the right yardage.

The chute is stretched out flat and the two upper corners are brought together at the middle of the lower side. The sides of the chute are then folded but not rolled together, in the manner shown by figure 3-5, the folds being not unlike the folds of an umbrella. In this manner the air is free to open a channel through the middle. All corners are brought together at the same place. As now folded it will occupy a space of about 18 by 50 inches. With the streamer placed at the end and the shrouds lined out on the ground without crossing each other, the chute streamers, shrouds, and all, are now rolled up, beginning at the top and ending with the shrouds. It should not be rolled tightly. The load is then tied to the chute and the chute is placed on top of the load ready to discharge.

Care should be taken to use strong material and substantial ties, for the chute will open up with a violent snap. As rolled up the chute forms a bundle about 6 by 18 inches. None of these chutes ever failed to open with the packs

as described later. This chute has been loaded up to 100 pounds, but then falls about twice as fast as when loaded with 50 pounds. Loads in excess of 100 pounds would be difficult for the dropper to handle, so none was tried. It is probable that a 100-pound sack of grain or other similar material slipped into another and larger sack, such as a mail sack, will land successfully and stand the impact, but this was not tried. Ordinarily not more than 50 pounds of supplies should be lowered. The folding of the chute does not have to be done with any great care, but keep in mind that it must be made to open as freely as possible with the inrush of air through the middle.

The pilot and the dropper.—The pilot's business is to approach the target while heading directly into the wind. After each load has been discharged the pilot should begin to turn so that the dropper may watch each bundle as it lands without getting too far away. It is particularly important that the pilot pass directly over the target. The pilot ordinarily cannot see the target when close to it or on top of it without side slipping, which is not advisable, since he is then not only losing elevation, but the loads also have a tendency to pass under the fuselage and may foul the tail surfaces. The pilot must, therefore, approach the target from some distance back so that he can get lined up.

The dropper watches the target, and the pilot notes his course and watches his altimeter so as to keep his elevation the same throughout. The general wind direction may be ascertained in various ways.

The dropper's business is to watch the target, drop the loads, and map the landing of each load. After the ship is unloaded he can drop this information to the ground crew. Dropper and pilot will cooperate in obtaining accuracy in dropping. It is absolutely essential that the dropper be equipped with one of the more expensive grades of goggles and a helmet. If not, he will stand a chance of seriously injuring his eyes from particles of oil, as well as air, driven into his face. The dropper should be tied to a lineman's belt and strap, secured forward to a structural member of the fuselage. The strap should be adjusted just long enough so that he may stick his head out comfortably through the door while leaning against the belt or the front doorjamb.

Dropping.—The dropper may first discharge a pilot load in order to ascertain the accurate direction and force of the wind if deemed necessary. This load may consist of a chute loaded with a sack of gravel weighing about 30 pounds, or may consist of a gunny sack with a 2- to 3-pound load in it and tied at the top. The chute load is the best. All chute loads will land in about the same place if discharged directly over the same spot; and,

in a slight breeze, flying at 500 feet, will land close to the target, if discharged directly above it.

The dropper takes hold of both the load and the chute with one hand and discharges both at the same time by pushing them out and down. If the load is heavy, he may have to help it along by an additional shove with his foot. If very heavy, he may set the load partly outside, nearly balancing it on the edge of the door opening, from which position it may easily be tipped over for discharge.

The loads all act with surprising uniformity, and there should be little trouble in coming within 200 feet of the target. It may be necessary at times, depending on the topography, to drop from 1,000 feet or more. In such a case a greater distance between target and load must be expected.

The loads should be numbered and marked, so the dropper may make a small diagram showing the north and south directions and local features, and plot the position of each load on this map. He can then drop this information to the ground crew in a weighted streamer before leaving.

The reasons why chutes have not been used more extensively in the past are perhaps that it was thought that the chutes would catch in trees, were expensive or difficult to make, and that the drift would be too great and uncertain. Chutes do occasionally land in the tops of trees. Out of 17 loads discharged over dense woods, 1 landed in the top of a tree, which had to be climbed. Frequently they land on the lower branches, from which they may be pulled down directly or by throwing a weighted line through the shrouds or over the load. Out of 17 loads, 3 landed in this way.

Owing to the relatively small area of the chute as compared to the distance between trees, and also because of the tendency of the shrouds to push the chute away from the branches, most loads land on the ground. The dropper can easily see when a load lands in the top of a tree, as the trailer is conspicuous from the air, and he can throw down a pair of tree climbers if necessary. The tree could, of course, also be cut down.

Particularly heavy or fragile articles may be lowered in a larger chute or in a cluster of chutes looking something like toy balloons. This method of tying the chutes was tried with groups of two and three chutes and worked well.

When two chutes were tied in tandem through a hole in the lower chute, the upper chute never opened, so this method does not seem to work. It is also more bother to arrange the chutes in this way.

There is, of course, a limit both the weight that a man can handle and the bulk that he can get through the door. This door opening

usually is from 26 to 28 inches wide, and one should figure on having about 3 inches clearance on each side, which limits the width of the load to about 22 inches.

A dropper must be sure not to let go of the chute until the load is sure to go also. *Failure to observe this precaution may cause the chute to catch on the tail surfaces and wreck the ship.*

Packing: kinds and amounts—

1. *Canned goods.*—The smaller the cans the more impact they will stand. Cans up to No. 2½ were tried, but No. 2 is probably the best can to use. The cans are placed on a square board, standing, as many as the board will hold (fig. 3-6). The largest board used was

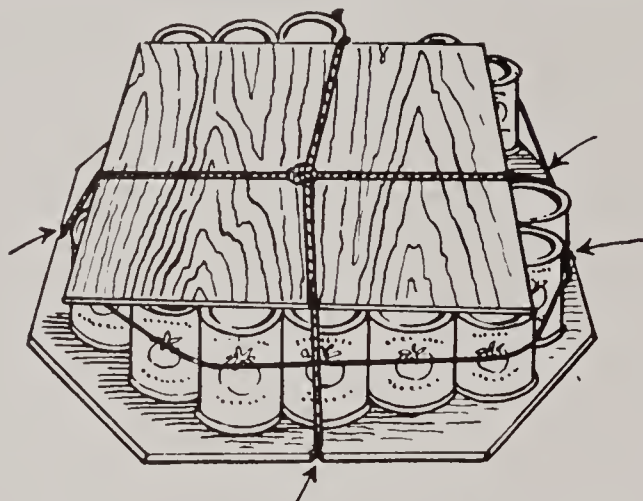


FIGURE 3-6.—Method of packing canned goods.

22 by 22⅜ inches, plywood. Use only a single layer of cans. The group of cans is tied around tightly with twine and will form a more or less circular group. A loose and somewhat smaller board is placed on top of the cans. The package is then tied together tightly across the sides. The edges of the boards are notched in the middle so the cord will not slip. The package is then suspended flat to the chute. A 22- by 22-inch board with corners trimmed off, so as to catch less air and thus increase the efficiency of the chute, will hold about 34 No. 2 cans weighing approximately 50 pounds. A 12- by 12-inch board will hold approximately nine No. 2 cans weighing about 13 pounds. Where no plywood is available, a square board larger than 12 by 12 inches can be made by nailing slats across smaller boards.

2. *Fresh meat, ham, bacon.*—Place each item in a sack and all together in a gunny sack suspended flat, if heavy, and tied across the ends and the sides. Load up to 50 pounds.

3. *Dry foods, such as sugar, salt, rice, spaghetti, beans, raisins, rolled oats, prunes, apples, dry vegetables, etc.*—These will stand a considerable impact, and it is a question of bulk rather than weight which determines the maximum load. Place each item in a separate small sack and load in box, carton, or gunny sack suspended flat, with the more susceptible articles on top. Do not pack very deep.

4. *Pickles and preserves in glass jars.*—Place several 1-pint jars, each jar standing and well wrapped in flour sacks or similar material, on a board and load same as canned goods. Attach a bread shock pad underneath. This pad is made of loaves of bread sliced and put into a sack side to side. The sack is then drawn up tight and tied to pack underneath. Largest load tried was 8 jars weighing 22 pounds. The bread will probably not be damaged.

5. *Bread—sliced (white).*—Place bread in carton, gunny sack, or box, and lower flat. If in gunny sack, put each group of three loaves in small sack and all in gunny sack, with a board under or inside the sack so the rope will not squeeze the contents when chute opens. A sackful of bread (white, sliced) may also be lowered in a gunny sack suspended flat and tied in three places to the end of a wool sack as is, the wool sack serving as a trailer without chute.

6. *Fresh vegetables—cabbage, cauliflower, lettuce, radishes, carrots, turnips, onions, etc.*—Put each head or bundle in a small sack and place all in a gunny sack suspended flat. Pack lettuce on top of the rest. If a board is used underneath, it will prevent rope from cutting into contents. The sack will hold about 35 pounds. Do not pack very tight.

7. *Potatoes.*—Lower a 50-pound sack flat. There may be a slight breakage, but the potatoes may all be used.

8. *Oranges and grapefruit.*—These were only tried in flat 12- by 18- by 4-inch and 12- by 24- by 4-inch boxes. Oranges used were small and hard.

9. *Butter.*—Two 1-pound packages of butter, not in tins, were lowered in a 28-inch braced gunny sack, but can be lowered in flat box. Do not lower more than 10 pounds at one time.

10. *Lard.*—Three pounds of bulk lard were put in paper wrapper and in small sack, all in gunny sack tied at end, no chute. Can be lowered in tins packed as tinned goods.

11. *Coffee and cocoa.*—Pack same as tin cans, but put small sack around each item.

12. *Eggs.*—Nine dozen eggs were placed in a half-crate box used for packing eggs on horseback. The rest of the box was filled on top with rags. Eggs were packed with ordinary separators and cells. Lowered with eggs on end and a bread pad under the load. It is probable that the full half crate, or 15 dozen, could have been lowered without damage. Load was 18 pounds with box. It is probable that lowering eggs may at times prove disappointing. On the other hand, it may well be that the old hen has never been given sufficient credit for the lopsided sturdiness of her product.

13. *Water in rubber-insert bags.*—Fill two bags half full of water and put them side by side in flat box. Bags should each be in a

knapsack and lie flat. Weight about 45 pounds.

14. *Rubber-insert bags—empty.*—Put several bags in a gunny sack tied at top and discharge.

15. *Water, gasoline, or other liquids.*—Use a heavy-type 3-gallon milk can with conical throat. Fill to the cone and suspend in rope harness with spacing twine tied between and to ropes to prevent ropes crossing bottom from sliding off. Tie around top also. Fit a board in space between flange and bottom. Weight 32 pounds, can included.

16. *Matches.*—Put each box of matches in a small sack and put a few of these into a gunny sack tied at top. Discharge without chute.

17. *Six-man cooking outfit (standard).*—Place the kit on a board with bread pad underneath. Weight 27 pounds.

18. *Five-gallon tins or single kettles.*—Place each can in a gunny sack tied at top. Tie all the sacks together in a circle, spaced about 1 foot, and discharge without chute.

19. *Gas lanterns.*—Leave lantern in original container or place in box padded with rags. Stand on board with bread pad underneath. Weight 11 pounds. Put box of mantles inside box. The chute will probably lower two lanterns without damage.

20. *Liquid-gas torch.*—Place in rope harness with spacer twine between and tie around top. Suspend standing up. Weight 33 pounds loaded.

21. *Shovels.*—Take a six-shovel bundle and suspend at point of balance. Weight 23 pounds. The chute should lower one dozen shovels without trouble.

22. *Double-bit axes.*—Take a six-ax handle with axes standing in standard box protecting bits. Pad between bits and also bits and top of box. Suspend, handles up, by rope around bottom of box leading up through handles and tied around top of handles. Weight 37 pounds. The chute will probably take care of one dozen.

23. *Six-foot saws.*—Put hose around cutting edge and tie hose to saws. Put two saws on top of a board bolted to them through handle holes. Suspend saws level and flat in a bridle tied to each end. Board should be wider and longer than saws. Discharge by putting one end of package out edgewise and downward about 2 feet and give final shove when over point of discharge.

24. *Ax handles, etc.*—A gunny sack filled with ax or hoe handles may be discharged directly without chute from a moderate altitude. If over 300 feet, use chute.

25. *Emergency rations.*—A sackful of emergency rations suspended flat should land without trouble, although this has not been tried.

26. A few don'ts:

a. Do not use wire hooks for attaching handles. They straighten out too easily and cut and rip too much.

b. Do not discharge a bundle if pilot passes to one side of the target. Wait till next time.

c. Do not be in too much of a hurry. Spot every load. Five or 10 minutes extra time spent in dropping may save the ground crew some time in searching and the dropper his reputation.

d. Do not let go of the chute until you are sure that the load will also go.

3-7, 3-8, and 3-9 illustrate various other methods of chute construction employed; but

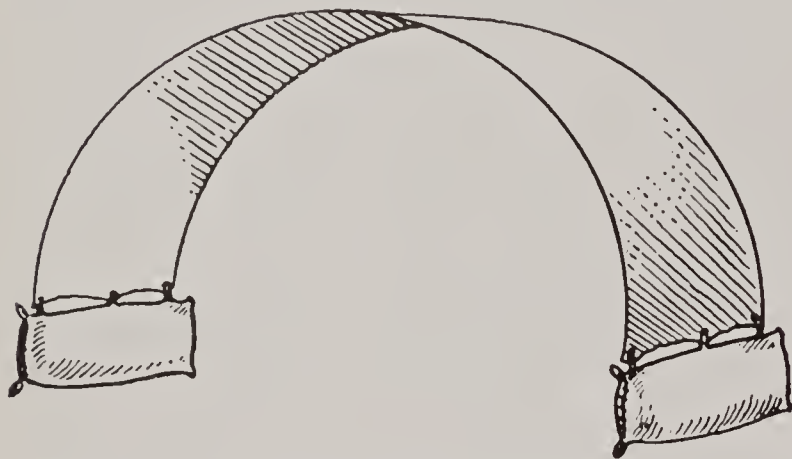


FIGURE 3-7.—Wool sack, double ender, efficient but a little inconvenient to handle.

none was as successful as the wool-sack chute previously described, when all-around efficiency and ease of handling are considered.

Summary of Airplane Dropping Methods.

The fire control equipment committee has given careful study to the three methods of delivering equipment and supplies by airplane, and recognizes peculiar merit in all three methods advocated. It seems inadvisable to recommend any one particular method for general use; rather, the choice of method or combination of methods is left to the judgment of those who intend to employ air delivery.

The experimental work in Region 1 was followed logically by the work in Region 4 which, in turn, was followed by the work in Region 6. In an uncharted field there has been orderly progress in the development of a new technique. It is a good example of step-by-

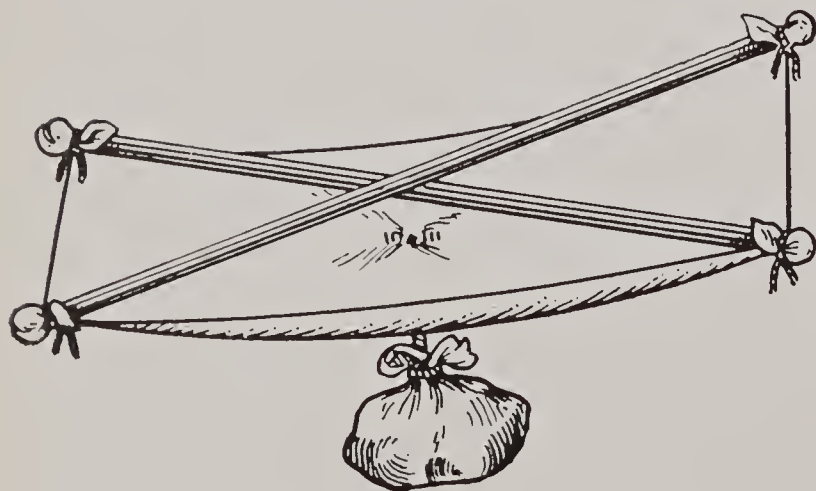


FIGURE 3-8.—Braced burlap, a piece of burlap stretched by two sticks, efficient but difficult to discharge, and bulky.

step guided evolution of method and equipment.

Aerial Delivery of Portable Power Pumps and Equipment.

Portable power pumps.—Region 1 has used the condemned Army freight parachute successfully in lowering portable power pumps from an airplane to the ground. The following information is offered in regard to the preparation of the pumper and container for aerial delivery by parachute dropping:

The pumper should be securely fastened to a wooden base and then should be covered over with a galvanized-metal hood, which in turn should also be securely fastened to the wooden base, preferably with stove bolts or with $\frac{1}{4}$ -inch carriage bolts and wing nuts. In mounting the pumper to the wooden base one or two layers of a good grade of sponge rubber an inch or so in thickness should be used between the pumper and the base at all contact points. The pumper should be mounted so that the heavier end of the unit will hang downward when suspended from the chute, and there should be about 4 inches of space from the nearest point of the lower end of the pumper and the end of the outer container. On the lower end of the outer container there should be tacked three or four

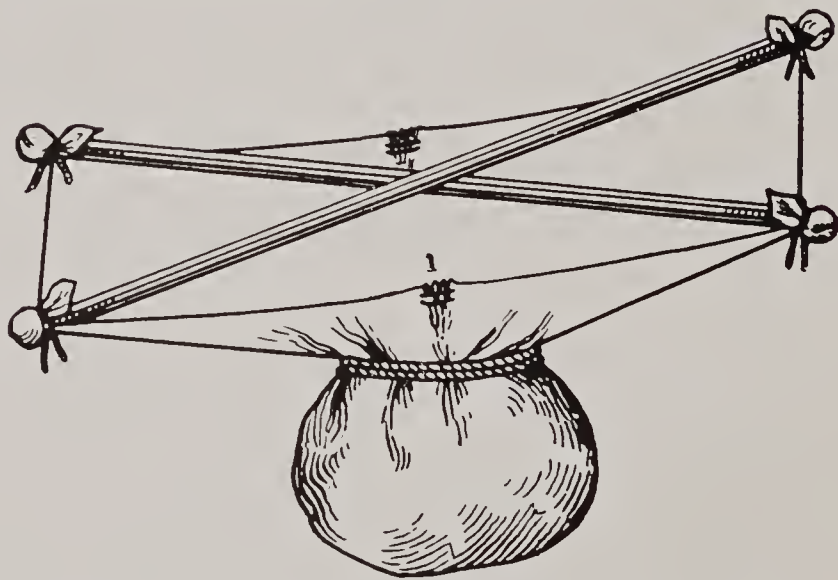


FIGURE 3-9.—Braced gunny sack, efficient but small capacity, difficult to discharge when sticks are too long, bulky. Sack is split down to point 1.

thicknesses of the sponge rubber to serve as a cushion should the bundle strike the ground with sufficient force to cave in the head of the container or jar the pumper loose from its base fastenings.

The parachute should be fastened to the pumper so that it will hang suspended and will drop in the proper position as intended. In fastening the chute to the bundle, from four to six strands of $\frac{1}{2}$ - or $\frac{3}{4}$ -inch elastic cord should be used. These elastic cords will then serve as a shock absorber to absorb the jerk or snap when the bundle is discharged from the ship and the chute opens.

The material used for both the pumper baseboard and end boards for the hood or cover should be plywood in order to avoid splitting or splintering. Twenty-four gage sheet metal will be found sufficiently heavy to serve for the cover.

Figure 3-10 quite fully illustrates the type of material to be used and the manner and method of arranging the pumper on the baseboard, and of attaching the parachute.

Accessories.—Accessory boxes containing such items as Siamese control valves, nozzles, wrenches, engine oil, tools, etc., may be lowered in the same manner as the pumper, except that instead of fastening the individual items solidly, they should be packed in a small amount of fluffy wood excelsior sufficient only to separate the various individual items. Any oil contained in the box should be so packed that it will be on the top of the rest of the contents when the bundle reaches the ground.

Both pumper and accessory bundles may weigh as much as 150 pounds and be lowered successfully with this particular type of parachute.

Hose.—Either fire hose or suction hose may be discharged from an airplane without the aid of a parachute, the only requirement being that the hose be rolled and securely tied so that all couplings are in the center of the bundle and well protected. It is not necessary to wrap the bundles, although it does no harm and insures a safer landing for the couplings.

Eye Test for Fire Lookouts.

Since the primary function of fire lookouts is to look for fires, it is customary to require applicants for this work to demonstrate their "seeing" ability. Ordinarily this test for quality of vision is given indoors, using the familiar, Snellentest chart with its rows of large and small letters. Although the Snellen test is satisfactory for the purpose for which it originally was intended, it does not appear to give reliable results when testing ability to see smoke of small fires at long distances.

While making studies to determine how far lookouts can see the smoke from small fires, the need arose for an eye test which could be correlated with the results of the smoke-dis-



FIGURE 3-10.—Portable power pumper, with parachute, ready for aerial delivery.

tance experiments. This new test is given out of doors, over a distance of several hundred feet, with the observer facing the sun, and thus better approximates conditions prevailing at lookout stations. Moreover, guessing is very nearly eliminated.

Briefly, the procedure with this lookout eye test is to determine how far a small, white spot on a black background can be seen. Those who must approach closer than 450 feet in order to see this white spot probably do not have sufficient keen vision to qualify as lookouts.

The equipment needed is (1) a piece of soft wallboard (such as Firtex) 22 by 36 inches, covered on one side with black percale or other dull black cloth, and (2) a white spot three-eighths of an inch in diameter. The white spot can be made by boring a $\frac{3}{8}$ -inch hole in a small piece of sheet metal painted with flat black paint, backing it with white cloth, and bending two edges down over a block of wood about five-eighths of an inch square by one-fourth of an inch thick. This metal cover may

be removed from the wood block for replacement of the white cloth when it becomes soiled. A needle or sharpened brad is fastened to the underside of the wood block (projecting about one-fourth inch) so that the spot may be fastened to or removed from the wallboard panel.

When giving a test, select a level place, such as a meadow, where an unobstructed view may be had for a distance of about 600 feet north and south. The examiner stands at the south end of the test course and holds the large, black panel about shoulder high with the long edge of the panel parallel to the ground. The cloth side faces north.

The test must be given while the sun is shining but the direct rays of the sun must not fall on the cloth side of the board during the test. (The examiner may hold the board in the shade of a tree.) The white spot is placed on the cloth side of the black panel, about 11 inches from one end and midway between the top and bottom of the panel. The person to be tested walks north about 300 feet from the examiner, turns, and if he can see the white spot from this distance, walks 15 or 20 feet farther, continuing in this manner until he can barely distinguish the white spot. Here he gives an arm signal for a check test. To give the check test—i. e., to determine if the lookout applicant is at the maximum visibility distance—the examiner reverses the black panel (or has the lookout turn his back to the examiner) and either (1) leaves the white spot where it is, (2) moves it to a similar position at the other end of the panel, or (3) removes the white spot. He then swings the board back to its original position facing the man being tested (or by a whistle signal notifies him to turn around). The lookout applicant then indicates on which end of the board he sees the white spot, or signals its absence. If incorrect, the examiner motions him to step forward about 5 feet. He repeats this check test a few times until he is satisfied that the observer has reached the limit of his vision. The distance from the examiner to the observer (measured to the nearest 5 feet) is referred to the following tabulation to obtain an eyesight rating.

EYESIGHT RATING SCALE

(For use in full sunlight)

Maximum distance at which white spot may be seen (feet) :	Quality of vision
Less than 300_____	Poor.
305 to 350_____	Fair.
355 to 450_____	Average.
455 to 500_____	Good.
505 to 550_____	Very good.
Over 550_____	Exceptional.

Those taking this test should be cautioned against staring too long at the panel; if the white spot is not seen within a few seconds, it is unlikely that continued searching will make it visible. The examiner will find that

many men must be motioned back to greater distances in order to obtain maximum distances. Men should be tested one at a time.

The test should be given between 9 a. m. and 3 p. m. for best results. The sun must be shining at the time of the test. (On cloudy days the white spot may be seen not as far or much farther than shown in the rating scale, depending on whether the sky is bright or dark.) It is important that the examiner keep his back to the sun when making the check test, for if the direct rays of the sun fall on the white spot when reversing the board the spot becomes abnormally visible and will be seen by the person being tested. The black panel is large enough not to be appreciably influenced by the character of the natural background behind the examiner, but it is recommended that the examiner select a dark background.

This test has been on trial by the Forest Service in various parts of the United States during the past 3 years, and apparently meets with the approval of those using it. This test, however, is not to be considered as being in its final form. Additional work is required to check the preliminary indication that the relative distance at which the white spot can be seen forecasts rather accurately the maximum distance at which small smoke columns will later be seen. As data collect, changes may also be required in the rating scale, especially the derivation of a scale for use during cloudy weather.

Should this kind of eye test prove desirable, it is suggested that a standard test outfit be made by gluing black cover board (or black blotting paper could be used) on each side of a 22- by 22-inch piece of stiff cardboard and sticking a white paper spot (three-eighths of an inch in diameter) in the center of one side of this board. The check test would then be made by twirling the board and asking the observer to signal whether the side with the spot or the side without the white spot was turned toward him. Additional gummed spots could be provided for replacement of soiled ones. The whole outfit could be kept in a stout manila envelope on which would be printed the rating scale and directions for use.

No attempt has been made to set up definite standards for acceptance of lookouts. One Forest Service Region, however, specifies that only men who rate good or better shall be used as primary lookouts.

Synchronized Sector-Observation Plan for Lookouts.

The number of fires initially discovered by regular lookouts is astonishingly low in some units. This has been disclosed quite often through analyses of reports of first discoveries and classification of the agencies making these

discoveries. In an effort to obtain better detection, especially of small fires, as soon as they start, a plan of synchronized observation has been worked out for lookouts during probable bad weather or when critical conditions exist. This method appears to have considerable merit and is worthy of some consideration where the detection system is of such intensity as to result in overlapping of visible areas from two or more lookouts.

The synchronized sector-observation scheme originated with Region 4 and according to that Region has proved quite satisfactory. A brief description of the method of obtaining synchronized sector observation is set forth herein.

(1) The area from each lookout is divided into five sectors, each to be allotted an equal amount of time for coverage by a searching observation. Each lookout's sectors are numbered in rotation to agree with the sequence of observation established.

(2) All lookouts' sector-observation rotations for a given protection unit are synchronized so that each area is under observation from some lookout at least twice during the period. This work can be varied to meet local requirements.

(3) If desired as a further check to insure observation of instructions by the lookouts, an observation record can be kept by each lookout when the sector-observation scheme is in effect. This record can be checked by the dispatcher whenever deemed necessary.

(4) The observation period can be any length of time desired, such as 3, 4, 5, or several minutes' time, as will best meet local requirements and tie in with the entire synchronized detection scheme for the particular unit concerned.

(5) The sector-observation schedule can be so arranged by groups of lookouts so as to permit midday meal periods, time out for rest, for obtaining water, etc., and still retain observation of the entire area concerned from one or more lookouts.

(6) The sector method calls for a searching study of each sector concerned to insure detection of small smokes difficult to detect by only casual observation.

(7) The synchronized sector-observation plan can also be supplemented by an occasional casual survey of the entire area surrounding any given lookout in order to pick up any fire which may have cropped up shortly after a given sector has been thoroughly observed.

In using this system of detection the sectors are marked off directly upon each lookout's map and the observation periods clearly indicated thereon.

Region 1 has employed a system somewhat similar to this in connection with night observation. The areas of overlapping detection are determined and the lookouts concerned are furnished with a schedule so that with the use of

alarm clocks set at proper intervals each lookout can take his turn at arising and giving the area a once-over for possible night fires. This scheme is, of course, used only during possibly dangerous fire weather and at times when there are no lightning storms occurring or that have occurred very recently. During lightning-storm occurrence and for a reasonable length of time thereafter night observation is required continuously.

Mounting Maps on Metal or Wood.

The following instructions will be found helpful in mounting lookout maps, dispatcher maps, etc., and if followed carefully a satisfactory job of map mounting can be done by anyone:

Osborne fire-finder map disks.—Fire-finder maps should be mounted on 24-gage galvanized iron disks, which should be perfectly flat, cut to the exact size for the fire finder, and with the rough edges ground off. The maps should preferably be lithographed on good quality paper. Blueprints and black-line prints are undesirable because they are apt to have an excessive amount of distortion. If it is desirable to use two maps of different scales, they may be mounted on opposite sides of a single disk. A satisfactory method of preparing and mounting a map is as follows:

1. Ascertain the precise position of the lookout station on the map and make a $\frac{1}{16}$ -inch hole at this point to facilitate centering the map on the disk in mounting.

2. Using red ink, draw a true meridian through lookout point. The length of this line should equal the diameter of the disk.

3. Write township and range numbers on the map, together with any other written additions or corrections to be made, using black india ink.

4. Cut out the map on a radius one-sixteenth of an inch shorter than the radius of the disk.

5. Drill a $\frac{1}{16}$ -inch hole through the exact center of the disk and lay the disk on a table with a pin protruding through the hole.

6. Using a varnish brush, apply a thin, even coat of white shellac to the disk and the back of the map, and allow the shellac to dry for several seconds until it becomes slightly sticky.

7. Grasp the map by the edges and center the lookout position by means of the protruding pin and hole in the map; allow the center to sag into contact with the disk, then gradually lower the edges so that the map falls into place without stresses. Work rapidly, as shellac becomes very sticky in 2 or 3 minutes.

8. Work over the entire surface of the map from the center outward, using the hands or a folded cloth to press it into contact. Remove air bubbles by prickling through the paper and forcing the air out. *Do not* use a roller when map is first laid and *do not* attempt to

work air bubbles to the edge of the disk, as this will cause distortion.

9. To protect the map surface, first apply a very *thin* coat of spar varnish or shellac and allow it to dry for about 24 hours, then apply one or two coats of spar varnish. Shellac is undesirable as a top finishing coat because it is apt to turn white when exposed to moisture, or to sunshine. Care must be exercised in applying the first thin coat as too much varnish will turn the map transparent and too much shellac or brushing of shellac will cut the drawing inks used and cause them to run or smudge. If it is desirable to secure a clear, smooth luster on the surface and remove the sticky feeling after varnishing, use a good grade of polishing wax and polish thoroughly.

The cost of time and material for single mounting is about \$1.50 per disk; for double mounting about \$2.50.

Bosworth fire finders.—Maps should be mounted upon Bosworth map boards in the same manner as upon Osborne fire-finder disks. However, a more desirable arrangement for the Bosworth fire finder is to use a galvanized-iron disk, similar to the Osborne disk, and cut to a diameter which will just fit inside the brass azimuth ring hold-down screws and yet allow the ring itself to rest upon the edge. In this manner the map can be mounted upon the light metal disk and taken to the lookout where the fire finder is used and properly centered and adjusted to the Bosworth board top with ease, requiring only a screwdriver to do the job.

Metal-backed dispatcher or platting maps.—Platting maps should be mounted on a single sheet of 14-gage perfectly flat galvanized iron in the same manner as fire-finder maps are mounted. After mounting is completed the metal sheet should be screwed to a board or table top.

Before the map is mounted, true meridians should be drawn through the centers of all lookout positions. If a dispatcher's protractor is to be used for platting, the meridian should extend north from the lookout position 6 to 10 inches. Should a lookout position be near the top of the map, the meridian may be drawn to the south. Red ink is preferable for meridians, but if several lookout positions are close together, different colors should be used.

Meridians must be drawn with the utmost precision, as an error in alinement of a meridian will result in a corresponding error in all plattings made from it. A convenient method of drawing an accurate meridian is as follows: Lay a sheet of paper on the map so that its edge cuts through the lookout point as a straight east and west line. Mark on the edge of the paper the exact position of the lookout point and of the nearest meridian lines to the east and west. Move the paper toward the top of the map 15 to 20 inches, match markers to meridian

lines, and make a dot on the map opposite the lookout marker. A straight line from this dot through the lookout position will be a true meridian. On account of the convergence of meridians the edge of the paper must be angled slightly at the upper setting to match the markers.

After the map has been mounted and before the protecting coats of shellac and varnish have been applied a hole should be drilled through the metal at the exact center of each lookout position. This hole should be made with a drill of the proper size according to size of pin in protractor to be used for platting. Before drilling, the point should be marked carefully with a sharp center punch. After the map has been shellacked and varnished the holes should be reamed with the drill.

Metal platting boards with maps mounted by this method cost about \$1 per square foot, including material and labor.

Wood and Fiber map boards.—Maps should be mounted upon wood and fiber boards in the same manner and using the same materials as for mounting upon metal. Soft fiber boards which are not printed should be given two heavy coats of shellac which should be allowed to thoroughly dry and set before mounting the map. Unfinished wood surfaces should also be treated to one coat of shellac before mounting the map, otherwise the wood absorbs so much of the mounting shellac that the map may not adhere tightly and evenly throughout.

White background for maps.—Where a lasting white background is desired for a mounted map, the board upon which the map is to be mounted, whether metal, fiber, or wood, should be given one or two coats of first-quality white paint or enamel of the type suitable for applying to the base material to be used. In the case of the Osborne fire-finder disks, Bosworth fire-finder tops, and metal boards of any kind, a good grade of white iron enamel will prove most satisfactory. After painting the base to be mounted, it should be allowed to dry for several days to insure the paint becoming entirely hard and thoroughly set. Before mounting the map, the painted surface should be sanded lightly with very fine sandpaper to take off the glaze and to smooth down any small bubbles or paint points.

There is less danger of having a map turn transparent on this type of mounting than when maps are mounted directly upon natural-finish metal, wood, or fiber backings.

Mounting Maps on Cloth Backing.

Procedure.—Cotton sheeting should be used in the mounting of maps. This sheeting may be purchased in various widths but the 90-inch and 72-inch widths are found to be most economical and practical for use when large maps must be mounted or when there are large quan-

tities of smaller maps which should be mounted at one time. The sheeting is on schedule.

The dry sheeting is stretched tight on a smooth board of sufficient size to accommodate the map or maps to be mounted. The maps should be dipped in a tank of water and placed face down on an adequate sized board, allowing the surplus water to drain off. The paste is then spread evenly over the back of the map, care being taken to cover the entire surface. The map is then placed face up on the dry sheeting and smoothed down carefully with hands and finally with a rubber roller. The map should dry overnight before removing it from the board. If removed before it is *thoroughly* dry, it will not lie flat.

Paste.—Dissolve 2 pounds of lump laundry starch in about 1 pint of *cold* water. Pour over this mixture 1½ or 2 gallons of boiling water, stirring until thick. A smaller quantity of paste may be made if desired. A larger quantity is not recommended as it becomes sour if kept too long. Paste should be strained through cheesecloth before using to remove all lumps.

Splicing and Mounting Maps—Paper to Paper.

Para-Lastik, a cement product put out by the Sheaffer Pen Co., will be found to be very satisfactory in paper-mounting work of any kind. It is especially suited to mounting maps on paper backings or for splicing two maps or other similar pieces of paper together. It is on the order of rubber cement but is much more efficient in that it does not allow the spliced pieces to be pulled apart as readily as does regular rubber cement.

In using the Para-Lastik cement, both surfaces of the papers to be spliced or mounted should be coated with a thin but even coat of the cement. This should be allowed to dry until quite sticky and then the papers put together in the position in which they are to remain. After adjusting the splices to their true positions, the two pieces should be firmly pressed into place and then should be weighted with several pounds of weight and allowed to dry for several hours if a permanent job is wanted. Care should be exercised to see that the spliced pieces do not shift at the time the weights are placed upon them.

Ordinary rubber cement can be used in this same manner. However, it will not prove nearly as satisfactory as Para-Lastik cement since it tends to release its grip after a certain length of time whereas Para-Lastik works just the reverse by setting harder as time goes on. Splicing work done with either Para-Lastik or ordinary rubber cement may be taken apart without damage to either the piece of paper or map concerned, for several weeks after the splice has been made.

Both Para-Lastik and ordinary rubber cement are very easy to handle because excessive cement which oozes out around the edges of the spliced pieces may very easily be removed with ordinary draftsman's art gum or other type of soft eraser without leaving any marks upon the map, paper, or whatever it is that is being spliced or mounted.

Waterproofing Maps, Photographs, etc.

Maps, photographs, and paper work of any kind can very easily be made waterproof as well as exceptionally weatherproof, by coating with a compound solution of acetone and plastacele or xylonite. The solution is prepared by using about the same amount of acetone as would be required if paint or varnish were to be used to coat the same surface. A sufficient amount of xylonite or plastacele, cut into small chunks or strips is added to this acetone and allowed to dissolve to make of the solution a sirupy mixture. The solution should be shaken often while the plastacele or xylonite is dissolving. After the solution is prepared it should be applied to the map, photograph, or other surface to be coated with a fine camel's-hair brush and allowed to dry thoroughly. If a thoroughly waterproof job is desired, both surfaces of the map should be given about two coats of the solution.

While mixing the solution, it should be kept away from fire or flame of any kind, since acetone is highly inflammable. If xylonite is used, it too will burn readily. Plastacele, however, will not burn unless exposed to direct flame and then it will melt slowly. The solution should be tightly corked after preparation because it evaporates very rapidly and will set in solid form within a short period.

The same solution can also be substituted for use in covering lookout maps in lieu of varnish. It provides a colorless, transparent coating and if two or three coats are applied, the map can be written upon with pen and ink or pencil, and the marks may be readily washed from the surface with a wet rag, even using soapy water.

Acetone can be procured from any drug store, and if required in large amounts, can be obtained at wholesale rate of about \$1 per gallon. There is no set rule as to the amount of plastacele or xylonite to be dissolved in a given amount of acetone, since it must be added in sufficient amount to obtain the consistency of the solution which is desired.

Plastacele will dissolve rather slowly and may require several hours' before being ready for use. Xylonite dissolves more readily. Celluloid or pyrolin can also be used to make this solution, but are not advocated due to their high degree of inflammability, which leaves the map or other item coated therewith highly susceptible to burning should a cigarette or other flame or fire be dropped thereon.

Fire-Camp Lay-outs.

Topography, accessibility, and water supply will always need to be taken into consideration in any camp lay-out and no standard plan can be followed except strict observance of proper camp sanitation and convenient arrangement of various functions to facilitate feeding and equipping the fire fighters.

Figures 3-11, 3-12, and 3-13 portray three model, fire-camp lay-outs so arranged as to provide orderly sequence. Supply trucks and pack strings should be unloaded or loaded as the case may be, at designated spots and supplies distributed to the various storage quarters. Men arriving in camps from the fire line leave their tools in the racks, proceed to the time-

keeper's tent to check in, and from there go to the place for washing, then to the feeding set-up, and move on out of the way. Fresh crews going out to work on the line reverse the process, going from the feeding set-up to the timekeeper's tent for checking out, thence to the tool racks to collect their equipment, and proceed to the job.

Water for camp use should always be taken from an uncontaminated source above the camp lay-out, and if feasible, may be piped to the kitchen set-up for convenience. Toilets and garbage pits must always be located below the source of water supply and 200 feet or more away from any stream and from the kitchen. Signs should be posted directing men

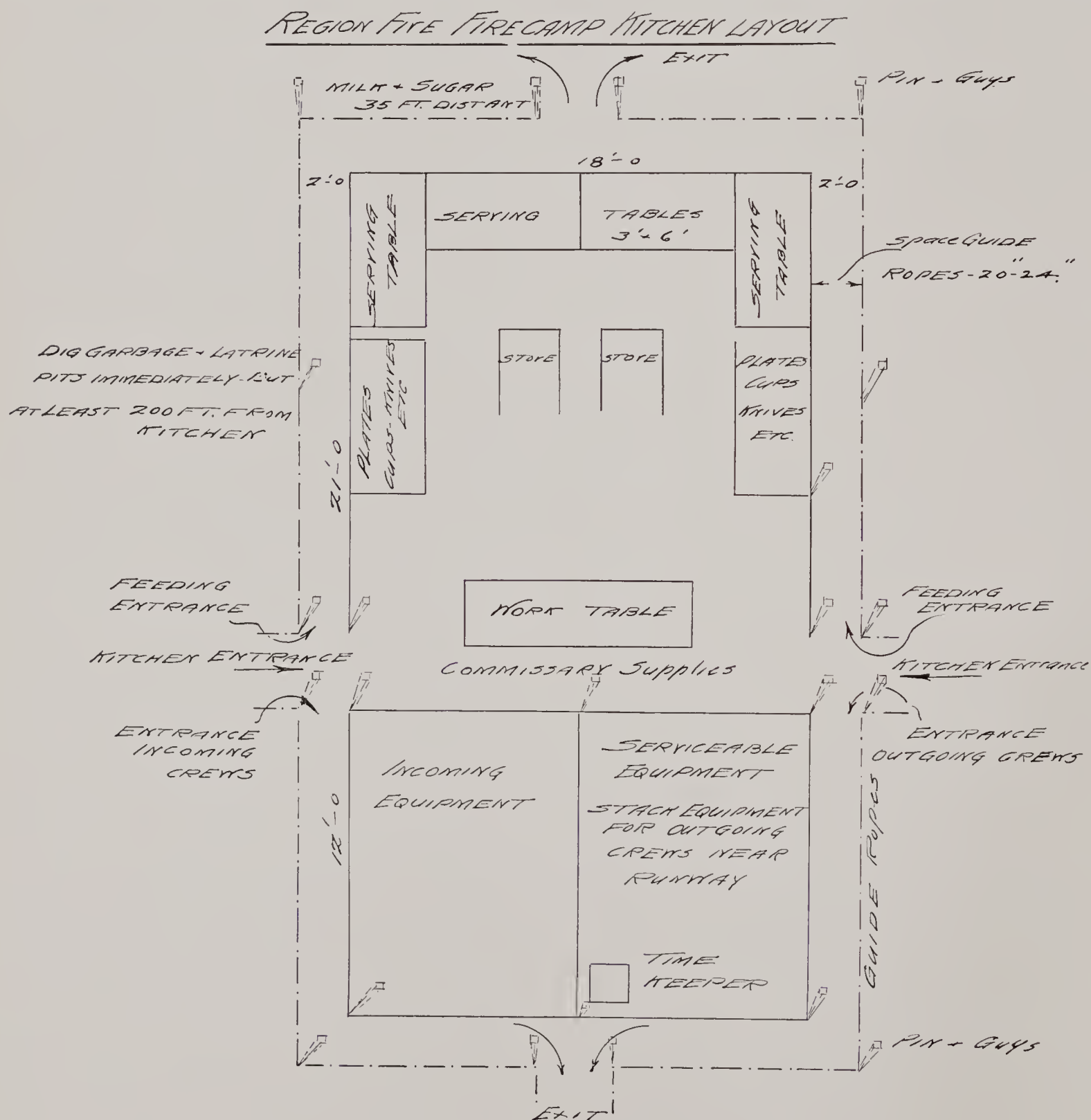
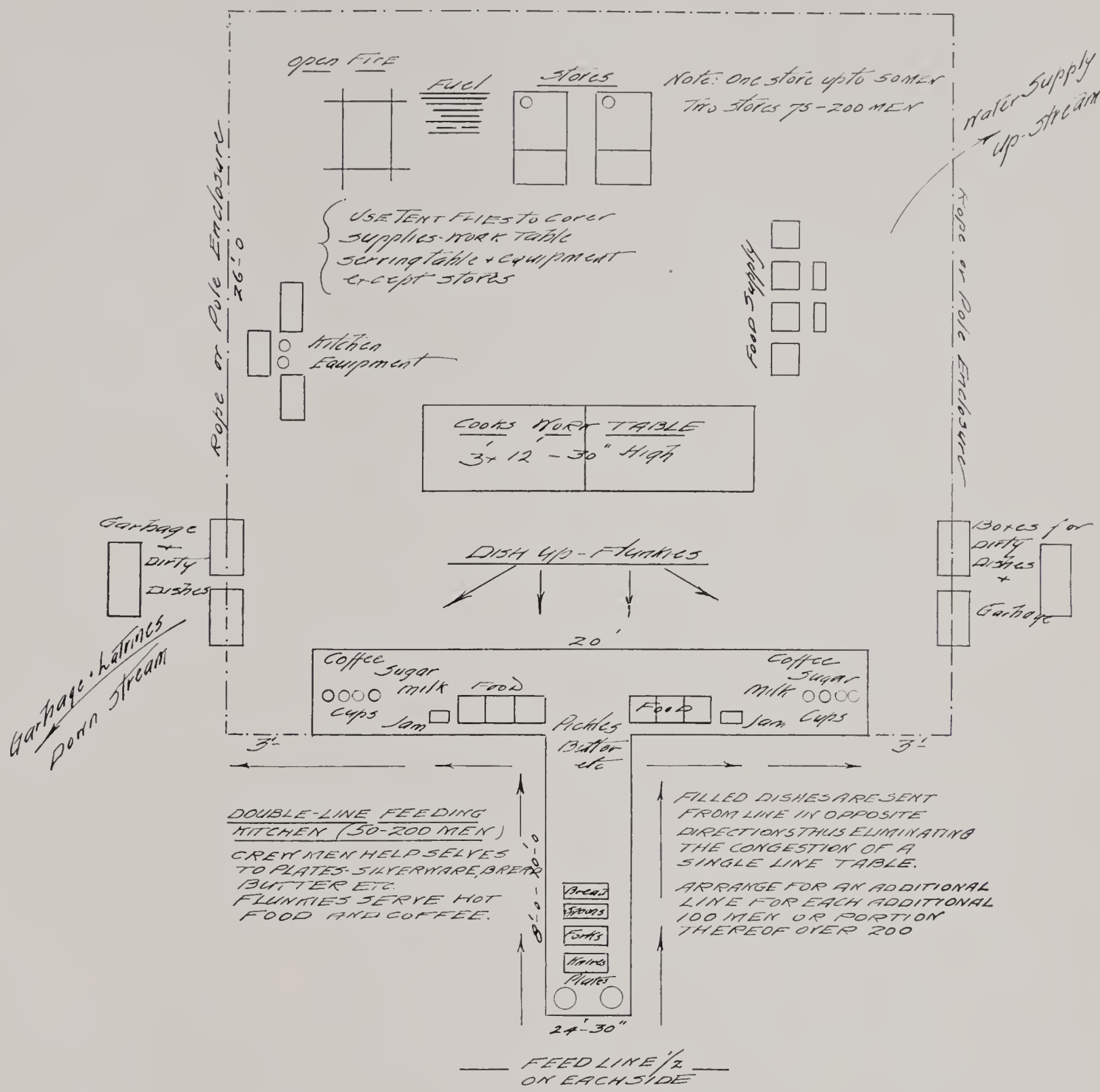


FIGURE 3-11.—Fire-camp lay-out No. 1.

REGION ONE FIRE CAMP LAYOUT



TIMEKEEPERS LAYOUT TO BE ESTABLISHED AT EDGE OF CAMPGROUND ALONGSIDE ROUTE TO FIRE. CAMP-BOSS, FIRE BOSS (IF BASE CAMP) AND COMMUNICATIONS QUARTERS USUALLY NEARBY

CREW BED GROUNDS TO BE ARRANGED SO CAMP NOISES
DO NOT DISTURB.

MAXIMUM TIME LIMIT TO FEED ANY SIZE CREW - 30 MINUTES.

SERVICEABLE TOOLS TO BE RACKED ALONGSIDE ROUTE TO FIRE

FIGURE 3-12.—Fire-camp lay-out No. 2. Close exits and entrances when not in use. Place butter, milk, sugar, coffee, bread, jam, salt, and pepper 35 feet away from the feeding exits to avoid bunching of men when feeding from both sides. Four hundred feet of rope will line out the camp and provide a surplus with which to expand the lay-out if necessary. This size lay-out will handle 200 men without crowding, and the minimum feeding rate should be 8 men per minute. Place power grinder and tool-repair set-up some distance away from this lay-out if telephone or radio is installed here in order to eliminate noise.

to toilets. Small poles to close off the various features are usually procurable on the ground, or rope may be used. Lumber for tables, benches, etc., in most locations may be secured at nearby saw mills and brought in on trucks as needed with other supplies, if the camp is on a road. When boxed rations are used, the box lumber makes very good table topping when laid upon a pole framework. The lath-and-canvas roll-up table top is also a convenient item of equipment.

Forests located in more open types, well equipped with roads or truck trails might find it feasible to construct folding tables for fire-camp use. Information on folding tables is given in part one, section E, Camp equipment.

Where possible, trucks and pack strings should come into camp against prevailing winds to keep dust out of supplies and kitchen. The campground should be sprinkled occasionally to settle the dust.

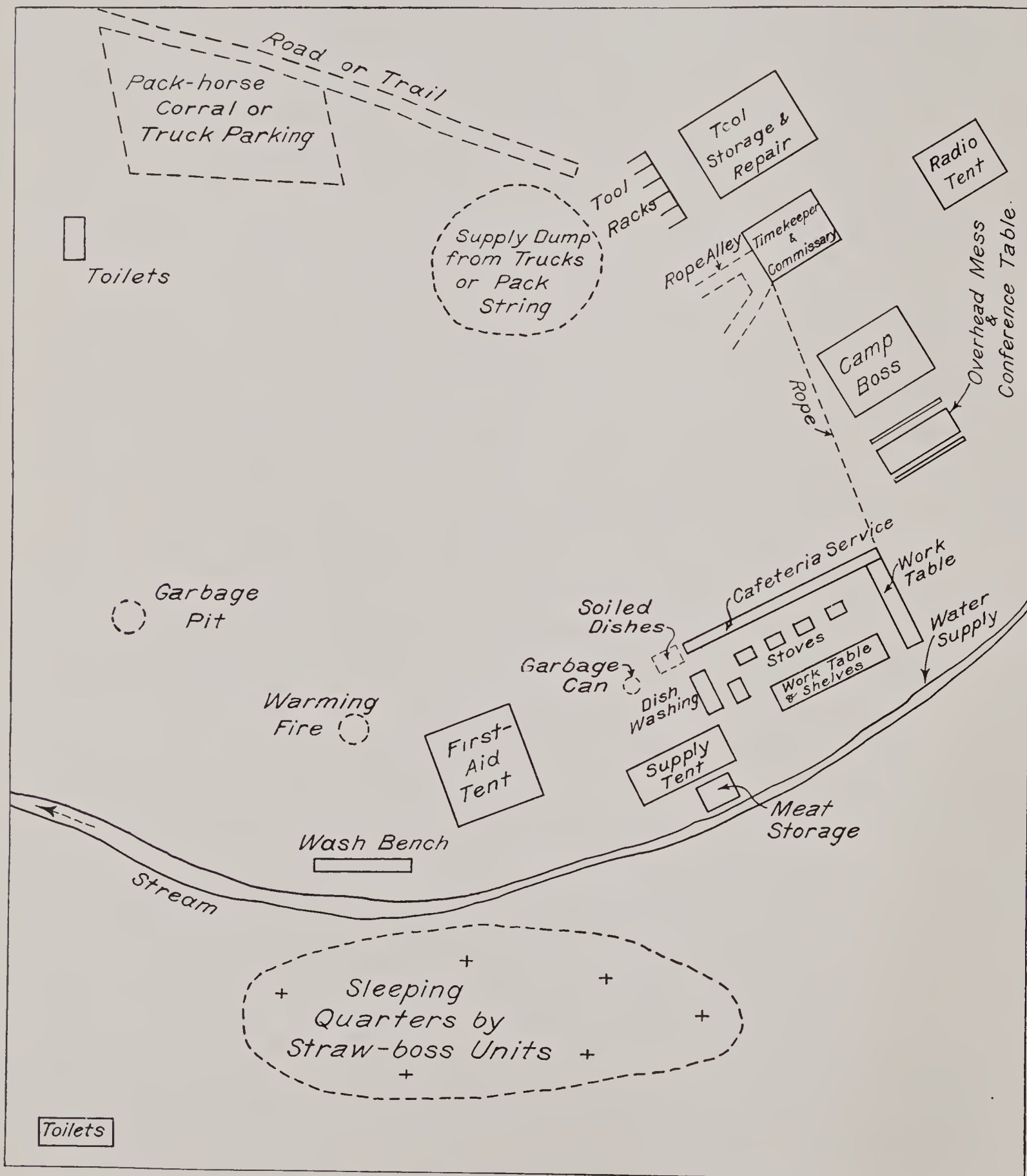


FIGURE 3-13.—Fire-camp lay-out No. 3.

Fire-Camp Lights.

Lighting is sometimes more or less of a problem around some of the larger fire camps. One of the most effective types of light, when available, is the large churn-base carbide flood-light used in connection with construction projects for night work. This particular type of light is quite expensive, however, and is not too well suited to horse transportation where that is necessary. The light uses the standard cake-form carbide and will burn several hours on one filling. The light stands about 5 feet high and has a large, bright-finished, circular reflector which provides sufficient light to adequately light up an area of several thousand square feet.

Another light which has been used to some extent is the portable-generator type which is driven by a small gasoline engine. A small amount of electric wire is strung on poles at proper locations around the camp and heavy-duty light globes used.

The twin-mantle gasoline lantern is hard to beat for all-round use in fire-camp lighting. This is the type of lantern described in part 1 of the handbook, section D, Lighting equipment.

Suggested Fire-Camp Outfit.

The following list furnishes an idea as to the quantity and type of equipment suitable for equipping a 100-man fire camp. The various items can, of course, be increased proportionately for larger camps. This particular outfit is designed more for roadside camps, however, than for back-country fire camps which necessitate pack-animal transportation.

The outfit as listed is used by several of the California forests and is contained in four large wooden boxes ready for shipment or transportation upon short notice.

2 50-man mess outfits.	10 Gallons aviation gasoline.
2 10- by 12-foot tents.	50 Headlamps, electric.
36 Mantles, Coleman lantern.	150 Batteries, flashlight.
24 Generators, Coleman lantern.	4 Water buckets, galvanized.
12 Globes, flashlight.	2 Shovels, long-handled, round-pointed.
1 Telephone, portable.	2 Axes, double-bit.
24 Dish towels.	1 Rake, camp.
12 Bars hand soap.	1 Pick, railroad.
24 Bars laundry soap.	1 Saw, crosscut.
6 Rolls hand paper towels.	2 Crosscut saw handles.
2 Garbage-pit signs.	1 Saw guard.
2 Latrine signs.	2 Sheaths, ax, double-bit.
12 Fire-direction signs.	1 Lock, pad, Forest Service.
2 Galvanized washtubs, No. 2.	2 Rolls (1 mile) No. 19, emergency wire.
6 Rolls waxed paper.	1 Lock, pad, Forest Service.
400 Paper bags, No. 8.	1 Forester's gasoline field range.
24 Rolls toilet paper.	1 Forester's gasoline water heater.
1 Carton matches, small boxes.	2 Funnels, filter, gasoline.
2 Tent flies, 14 by 16 feet.	3 Tables, fire-camp.
1 Outfit, camp-boss.	
2 Large first-aid outfits.	
400 Feet rope, ½-inch.	
12 Lanterns, Coleman gas.	

Marking, Branding, and Painting Fire-Control Equipment.

Various methods of marking, branding, and painting fire-control tools are used by the different Regions. Forest Service Form 424 (revised June 1936) sets forth the standard method of marking Forest Service property. This form, however, does not include all of the items which should be branded or otherwise marked. The fire control equipment committee assumes that the forthcoming equipment section of the national-forest manual will specifically establish a standard method of marking, branding, and painting Forest Service property. The committee therefore refrained from setting up any standard method herein. It has, however, endeavored to afford handbook readers within the Forest Service with certain pertinent facts and information regarding this particular subject.

One recommendation which the committee wishes to make is that unless necessary to brand or otherwise mark tools while they are in the process of manufacture, the manufacturer or dealer should *never* be requested to brand tools before delivery. The reason for this recommendation is that when tools are rejected on account of not meeting specification requirements, there is no way in which the Forest Service can prohibit the manufacturer of these tools marked with the Forest Service brand selling them to outside agencies and individuals since the tools are definitely still the property of the manufacturer or dealer concerned. Several instances of this nature have come to light within recent years and in one specific instance known to this committee, tools so branded were picked up by a forest officer and after investigation, it was found that the tools had been sold in a legitimate manner to the individual who possessed them and there was therefore nothing the Forest Service could do about reclaiming them as Government property.

About the only items which need to be branded or marked while in the process of manufacture are those which are marked by embossing or etching. Gasoline lanterns, canteens, medicine kits, metal pump accessory boxes, and possibly crosscut saws, and items of a similar nature, are about the only ones which must necessarily be branded in this manner. In the case of crosscut saws it is quite possible to die stamp these in a manner which makes it rather difficult for anyone to obliterate the stamping, although etching is, of course, preferred.

Canvas goods of any nature, blankets, fire hose, and other similar items can very easily be stenciled with indelible ink after inspection and acceptance of the items. Metal tools and equipment of any nature, other than those constructed of light sheet metal, can be stamped

with a steel die in a satisfactory manner, even including such items as alidades and other detection instruments.

Where painting is desirable, the color used should always be a deep red, since it is desirable to have this color specifically denote fire equipment. It is believed that this is quite universally accepted as the standard method for designating fire equipment by painting. The paint should never extend beyond a point where it is necessary to grip the handle or tool when in use.

Refer to the national-forest manual for further detailed information for standard methods of marking, branding, or painting fire-control tools and equipment.

Sharpening Fire-Control Tools.

Axes and similar edged tools.—There are various methods of sharpening axes and other edged tools, each of which will produce a satisfactory cutting edge for the purpose intended. Opinions vary, even among experts, as to the one proper method for efficient sharpening, grinding, and whetting, of all those in common use. Therefore, to endeavor to settle such a question by setting forth herein what might appear to be the one proper method has not been attempted. However, there are certain basic principles and facts directly connected with the sharpening of such tools and upon which experts do agree which can be and are set forth briefly for the information of others.

Dry grinding.—There is a popular belief among fieldmen that edged tools such as axes and brush hooks cannot be properly sharpened with dry grinding wheels such as axolite, carborundum, etc. This idea antedates the introduction of the manufactured abrasive used in grinding wheels and is a relic of the days of the wet grindstone. A canvas of leading Pacific coast grinding companies establishes the fact that practically all but special grinding work can be done with dry wheels. Edged tools, such as axes and the other types of hand tools used in forestry work, can be ground dry.

Dry-grinding wheels can be obtained to do any class of work, and the grinder-wheel manufacturer can provide a suitable wheel if given information on the class of work to be performed.

The classification of grinder wheels has recently been revised and is rather complicated. Manufacturers much prefer to have the purchaser state the kind of work to be done, the size of the wheel desired, and the operating speed to be used. This information will enable the manufacturer to provide a suitable wheel. The most satisfactory power grinder wheel for ax grinding work in the 1½- by 10-inch size is the 36-W-M. This wheel is a free-cutting, cold

type—which does not mean that the tool will not get warm but rather that the wheel will not get hot. Only moderate pressure should be applied to the tool while grinding, moving the tool so that the grinding is not concentrated at one point and dipping it in water occasionally to prevent overheating. No tool should ever be ground so rapidly that it becomes too warm to handle comfortably. The thinner the blade, the greater the care needed in grinding to keep the tool heat within proper limits. The cutting edge of an ax or similar tool should be ground with extreme care. The best practice is to finish the cutting edge on a wet grindstone.

Wet grindstones leave a wire edge on tools equally as much as dry-grinding wheels. Such an edge is not suitable for cutting; the wire edge soon turns over and leaves the tool dull. All edged tools should be whetted with a hand stone after grinding to remove the wire edge. A tool having a wire edge on the cutting edge is quite susceptible to chipping or nicking, especially if used in hard wood or knots.

Wet grinding.—This method is, of course, by far the safest method of grinding edged tools. It is to be preferred where men who have had no previous experience in tool grinding are to be employed. The only disadvantage of wet grinding over the dry grinding is the cutting speed of the stone, which requires a much longer time to properly grind a tool. On the other hand, however, the wet-grinding method has one big advantage over the dry-grinding process where inexperienced men are concerned, and that is the impossibility of “burning” tools by overheating and thus destroying the temper. Probably the most satisfactory all-round method is, as previously indicated, a combination of both dry and wet grinding performed by experienced men. Men experienced in grinding who are also familiar with the particular tools to be ground and their intended use, should be employed, since overheating is not the only way in which an ax or other tool can be improperly ground. Shape of the bit, the thickness, and the bevel of the cutting edge must also be given proper care. These vary appreciably, depending upon type of work to be done and also type of tool concerned.

Filing.—This method of sharpening edged tools is satisfactory in every way provided the work is properly done. It is, however, a tedious process and tools so sharpened usually wind up with “dubbed-off” cutting edges which require heavy grinding to restore them to proper shape. Filing is not advocated except as a temporary expediency and then it should be properly done. In order to avoid personal injuries, tools to be filed should be securely fastened in a convenient position and a handle should be used upon the file.

Shaping.—The shape to which cutting bits and edges are sharpened depends entirely upon the type of tool concerned and the sort of work it is to do. Axes should always have an even rolling bit, thickness depending upon type of chopping work to be done. Beveled tools should always be ground or sharpened so as to retain a proper bevel because the tool bits grow shorter through wear. Doubling-off is a common fault to be found in tools when sharpened hurriedly or by inexperienced men. Tools with dubbed-off cutting edges are far from efficient and are the direct cause of much lost effort.

Grub hoes and similar digging tools.—Use files or grinders to sharpen tools of this group which are only slightly blunt or dulled on the edges. The average mattock and grub-hoe bit is at proper angles if the ground or filed face is approximately one-half inch deep. The hazel hoe and adze hoe cutting bit is at proper angle if the ground or filed face is approximately three-eighths of an inch deep. Do not grind or file the edge of the outside face of any of these tools.

Very dull tools of this class can be properly sharpened only by heating and reshaping with a hammer, followed by treatment as just described. Heating and reshaping requires the skill of an experienced tool dresser and is *not* to be undertaken by a novice.

It is not considered advisable to sharpen the hoe portion of Pulaski tools by heating and drawing because of their thin construction and the high-grade tool steel used in them. In fact, properly ground bits are equally as serviceable and satisfactory as drawn bits. Therefore, there is nothing to be gained by forge heating and hammer drawing, whereas, if not properly done there is much to be lost.

Thin-bladed saw-steel hoes, McLeod tools, etc., should always be ground sharp. It is even inadvisable to draw thin-bladed hazel hoes except in special instances and when the work can be done by an experienced tool sharpener.

Shovels.—While rarely done, it will be found a dividend-paying proposition, from an efficiency and output standpoint, if shovel blades are kept sharpened to a good, keen bevel not too thin or long. This can be very easily and quickly done with an emery stone or by filing.

Crosscut saws.—Sharpening crosscut saws requires skill and experience; therefore, it is both difficult and impractical to endeavor to put down in written form a set of instructions which anyone can follow and perform a satisfactory job of saw sharpening. Manufacturers have bulletins available which set forth the guiding principles for saw filing. There is also available a booklet entitled "Sharpening Crosscut Saws" which can be procured from the Superintendent of Documents, Government Printing Office, Washington, D. C., at 15 cents.

Rehandling of Fire-Control Tools.

Just as there are different ways of grinding fire-control tools, so there are various methods of rehandling tools which prove quite satisfactory. However, there are a few basic principles which should be adhered to regardless of the method employed. A few of the more important pointers concerning the rehandling of fire-control tools are set forth briefly for those who wish to make use of such information:

Axes, brush hooks, Pulaskis, sledges, etc.—The first step should be to remove the old wedge from the handle, if possible. If a wooden wedge has previously been used, this can usually be accomplished by employing a narrow, but sturdy, chisel and prying the wedge out from the sides. If a steel wedge and nails, etc., have previously been used, a cold chisel or similar tool should be used in an endeavor to take out the wedge so that damage to the chisel will not result. After removal of the wedge, the handle should be cut off with a saw or chisel flush with the inner edge of the eye and the stub driven out toward the outer end of the tool head or eye. This direction is preferred since most axes and similar tools which are nonreversible are provided with tapered eyes, the outer end being the larger opening. A steel mandril slightly smaller than the tool eye and slightly concave at the driving face makes a satisfactory tool for this purpose. The concave face tends to draw the wood together and away from the sides of the tool eye.

The new handle should be shaped to fit the eye perfectly throughout. The best method of fitting is to use a spoke or drawshave for the heavier work, finishing the handle with a wood rasp. During the fitting process the handle should be tried in the eye frequently, driving it in with a wooden mallet and then removing it to determine high spots, etc. If an old tool is being rehandled, the high spots will be indicated by rust, and if a new tool, they will be disclosed by shiny spots on the handle.

After the handle is properly fitted to the eye and driven in place so that the inner edge of the eye is about one-half inch from the shoulder of the handle, the outer end should be sawed off flush with the eye and split longitudinally through the center with a wide-blade chisel. A suitable softwood wedge thoroughly seasoned should then be driven into the split end of the handle. The wedge should be constructed from straight-grained material and should be long, thin, and evenly tapered.

The type of wood to be used for wedging tool handles is the subject of some controversy. However, most experts are agreed that the most desirable type is straight-grained maple and that in lieu thereof, when this is

not available, the second best material is a strong, tough, straight-grained softwood similar to the various species of pine or spruce.

Short, thick wedges should never be used because they provide insufficient bearing surface which tends to permit the handle to work loose quite readily.

Moisture content of handles and wedges.—Study of this particular subject has disclosed that probably the most efficient moisture content for insuring a tight handle without causing weakness therein is around 12 to 15 percent. When tools are rehandled with handles having a lower moisture content, there is a brashiness introduced which materially weakens the strength of the handle and causes it to break more readily at the eye. Handles containing a higher moisture content are very apt to become loose in a short while.

Soaking loose handles.—As a temporary expediency, soaking handled tools in water will tighten the handles so that they will become serviceable for a short while, but in the long run, this method of tightening the handles does more harm than good in that the tools soon loosen even to a greater extent than before they were soaked. Also, it tends to introduce rust between the metal and the wood which breaks down the cell structure of the wood and causes still further loosening of the handle.

Tightening handles with oil.—Boiling tool handles in linseed oil or otherwise soaking them in oil solutions merely aggravates the loose-handle difficulty. They may remain tight for a short period after such treatment, but like soaking in water, the treatment in the long run is worse than no treatment at all. The oil impregnates the wood, seals the cells, and produces a brashy condition in the wood fiber. In addition to this condition, a lubricant has been placed in the eye which tends to permit the handle to work more easily in its socket.

Loose handles.—The loose-handle problem, particularly with axes, brush hooks, and similar broad-eye tools, is an ever-present bogie. One reason for this is the great number of such tools in use.

It might prove helpful to briefly analyze the mechanics involved in the handling of tools and keeping them tight. First, there is an eye shaped of metal which does not exert any springing effect on the handle. It is solid resistance. The eye section of the handle is live wood; that is, it has the property of returning to its shape after being compressed providing the pressure applied has not been great enough to crush the cell structure of the wood. Further, the wood has hygroscopic qualities. It will pick up moisture from the atmosphere and return it to the atmosphere, depending on the relative humidity. It is this action which causes handles to become loose during midsea-

son. During the winter months the handles absorb liberal quantities of moisture in various cycles depending on the moisture content of the surrounding air. This expansion within the eye is great enough to crush the wood cells on the surface. Subsequent loss of moisture causes the handle to shrink and the initial looseness which develops is the result of smaller size due to the crushed cells.

The best known cure for loose handles is to remove the old wedge and re wedge with a satisfactory type of new, wooden wedge, or, if not too loose, to reset the old wedge.

Hoes, and similar tools.—Tools of this nature should have the handles carefully fitted to preserve true alinement and to insure an even and solid fit through the entire tool eye. A wood rasp is the best tool for use in fitting handles of this type. Handles should be tested in the same manner as suggested under axes by driving into place and then removing to insure an even fit through the eye. It is quite essential to secure a perfect fit, otherwise "rocking" of the tool head is very likely to result when the tool is put into use. Tools of this nature which are slipped on over the entire length of the handle should be fitted so that about one-half to three-fourths of an inch of handle protrudes through the eye when first fitted. This will allow for wear and subsequent tightening of the handles by driving farther into the head of the tool. Wedges of any type should never be used in handling these tools.

Rakes, etc.—In some cases it is desirable to procure handles which have the steel ferrules already fitted in place. Tools of this nature ordinarily should be rehandled in a shop where such rehandling tools as a vise, rasp, brace, bits, file, cold chisel, rivets, and hammer are available. In rehandling, the handle should be carefully sized to fit evenly throughout the length of the ferrule.

Shovels.—It is neither practical nor economical to rehandle shovels. Broken-handled shovels should be replaced with new tools. The only material salvage value possible is in the blades of broken shovels that can often be used for making up other tools where a machine or blacksmith shop is available.

Oiling or Greasing Fire-Control Tools for Storage.

Of the various articles of fire-control tools and equipment, only saws, augers, ax bits, lanterns, and similar equipment need be greased. It is not considered in the interest of either economy or time, or proper care of equipment, to grease rough tools, such as shovels, rakes, hoes, and mattocks. No more effective material can be recommended than mineral oil for the purpose of preventing the rusting of saws. The next in order of preference is cosmoline,

used by the United States Army. Cosmoline becomes tacky and difficult to remove if it stands a long time.

Before oiling saws or other tools, be sure to remove all accumulated rust or coatings of pitch. Steel wool is effective for this purpose. Rust on axes can be easily ground off. In applying a grease to edged or pointed tools, make sure that the extreme points and edges are coated.

If a more lasting rust preventive is required or one which will not readily rub off, either of the two following solutions may be used satisfactorily: (1) a thin coat of boiled linseed oil, or (2) a thin coat of Oronite priming solution. The latter is a black, oil-base solution which dries about as quickly as boiled linseed oil but is more resistant to corrosion. Either coating will wear off in a satisfactory manner as soon as the tool is put to use. Oronite is a Standard Oil Co. product; doubtless other oil companies have a product which will serve the same purpose.

Cleaning, Oiling, and General Care of Mess Equipment.

The following outline covers briefly various satisfactory methods of cleaning, oiling, and storing the usual run of mess equipment which is employed in connection with fire-control work:

Cleaning.—Soot, fire blacking, and grease may be removed from tinware by one of the following methods:

1. Soak in hot water containing about one can of lye to each 5 gallons of water. The utensils should be allowed to soak for some time in this solution and then should be removed, rinsed in clear water, and immediately washed in a third vat or tub of hot water. The lye solution does nothing more than cut the grease, soot, and blacking so that it may readily be washed off in warm soapy water. This solution should be used only upon tinware. Aluminum ware should *never* be put in lye water.

When washing heavy pots, pans, griddles, and similar items which have become exceptionally heavily coated, the lye solution may be strengthened to two cans of lye to 5 gallons of water, or even more. When using this strengthened solution, care should be exercised to see that it does not come in contact with the bare hands.

2. Another solution which works equally as well as the lye solution may be made by adding 8 ounces of Aviation Turco Cleaner to the gallon of water used. This solution, like the lye solution, may also be strengthened for exceptionally grimy and blackened utensils. The Turco Cleaner solution is *not* injurious to aluminum ware as is the lye solution; therefore, utensils of all kinds may be cleaned in it. After soaking in the Turco solution, the

utensils should be rinsed and washed in the same manner as when using the lye solution.

3. A solution of one teacupful of oxalic acid to 5 gallons of water may be used satisfactorily for aluminum ware. The utensils are allowed to soak in this bath and then washed in the same manner as previously described. There are several types of cleaning wools or combination cleaning wools or combination cleaning wools and soap cakes on the market which are suitable for cleaning aluminum ware. Coarse steel or copper fiber Mystic Mits, Chore Boys, steel wool and other types of harsh abrasives should never be used in cleaning aluminum ware as they are too sharp and scratch the aluminum ware excessively.

Drying.—After thoroughly washing and cleaning, mess equipment should be thoroughly dried. This may be done by hand, using drying towels, or by using electric heaters and fans, or by drying the utensils in an oven. Whichever method is employed, the utensils should be made bone dry before they are prepared for storage. Before drying, and immediately after washing, each item or utensil should, of course, be thoroughly scalded in boiling hot water in at least one bath and preferably more. This not only makes the dishes dry more readily, but also insures against any soapy or greasy substances remaining thereon.

Oiling.—All kinds of cooking and mess equipment, except, of course, aluminum ware, wooden articles, etc., should be given a thin coat of mineral oil before being repacked or stored. In coating the utensils with mineral oil, they should be fairly warm and the oil should also be kept at a temperature which will permit easy handling. In applying the oil, the best method will be found to be to use a soft cotton rag or cloth which has been saturated with the warm oil and thoroughly wrung out. The *thinner* the coating on each utensil the better, provided no spots are left uncoated.

In many instances an endeavor has been made to oil cooking utensils by dipping them in hot oil. This method is not satisfactory because it leaves entirely too much oil on the dishes, thus necessitating washing them again before they are ready for use.

Storing.—Cooking and mess equipment which has been thoroughly cleaned, dried, and properly oiled, can be nested together and stored in this manner without danger of rusting. In storing oiled mess equipment, it is best to place it in a thoroughly dry place, preferably of even temperature, although this is not entirely necessary. Tinware and steel articles which have not been oiled must be stored in a thoroughly dry place and it is desirable to keep them at a moderately warm, even temperature because variation in temperature or

exceptionally cold temperature induces condensation and causes the dishes to rust.

Aluminum ware can, of course, be stored almost any place where it is reasonably dry since this type of equipment does not rust. However, under certain conditions it will discolor to some extent if not given some attention.

Care of Harness, Packsaddles, and Riding Saddles.

Harness.—In washing, use tepid water, a neutral soap, such as castile, and a sponge or fairly stiff brush. Remove all hardened grease and caked dirt by scraping. After washing, rinse in clean, tepid water, then hang in a warm place until it is no longer wet but still damp. In that condition the harness is right for oiling or greasing. Dry leather may take up so much grease that it will pull out of shape.

Neat's-foot oil and tallow is an excellent dressing for harnesses. It is improved if mixed with enough wool grease to make a paste about as thick as butter. In case the greases and oils mentioned are very expensive or difficult to obtain in sufficient quantities, they may be mixed with equal parts of heavy mineral oil, petroleum, or paraffin, or a mixture of these substances.

While the leather is still damp, apply liberally the grease or oil which is just comfortably warm to the hand. Rub in the dressing thoroughly. Hang the harness in a warm place overnight and then rub off with a clean dry cloth the excess oil which the leather has not absorbed.

Rigging of packsaddle.—Leather breeching and breast straps are far more satisfactory than canvas since, if leather is kept soft and pliable, it is less likely to chafe an animal than canvas. Keep leather packsaddle rigging in proper condition by using the treatment recommended for harnesses.

Saddles.—Cleanse the leather of the saddle thoroughly with tepid water and a lather of saddle soap or any other soap free from acid and alkaloid, as, for example, genuine castile. Apply the water and lather with a sponge or a soft cloth. While the leather is still damp and warm rub on a succession of like coats of genuine neat's-foot oil (beware of imitations). The oil should be warm but not uncomfortably hot to the hands. Rub the oil well into the leather, continuing until the leather will readily absorb no more. Let the saddle hang in a warm place for 24 hours or so. The saddle should then be washed again with tepid water and lather of some neutral soap in order to remove the surface residue of the oil. If the oil has been thoroughly worked into the leather and then if the leather is carefully washed, there will be no likelihood of soiled clothing resulting when the saddle is used. The method

given is recommended by two manufacturers of saddles in different parts of the country. Both of these authorities state that they have little confidence in petrolatum, viscol, and vegetable oils for saddle dressing.

Treatment of brittle leather.—First soak in clear water until soft, then remove and wrap in burlap or any other porous cloth to make possible slow evaporation. The following day treat the leather with an appropriate kind of grease or oil. If the treatment is given during hot, dry weather, thoroughly wet the cloth in which the leather is wrapped. This retards evaporation and assures that the leather will be damp the next day. Do not oil or grease the leather if it should dry out overnight. Wet again and try it over.

Mildewing.—Any leather article is almost certain to mildew if kept in a warm, damp, and dark place such as a closet, cellar, or stable. This mildewing probably will not reduce seriously the serviceability of the article unless it is allowed to remain on the leather too long. It may, however, change the color appreciably, thus injuring the appearance. The simplest way to prevent mildewing is to keep the leather in a well-ventilated, dry, well-lighted place. When mildew develops, wash off with soap and warm water or simply wipe off with a moist cloth. Dry the leather well afterwards. These simple measures are preferable to the application of preparations designed to prevent the growth of mildew.

Care of Canvas and Canvas Goods.

Duck deteriorates from a number of causes.

- (1) Mildew, the chief cause.
- (2) Bacterial action.
- (3) Chemical action.
- (4) Folding heavy canvas.

Duck mildews quickly under conditions of warmth, absence of light, and a moist atmosphere.

Bacterial action takes place when canvas has lain for some time in contact with a damp floor. This produces no change in color but weakens the fabric.

Destructive chemical action is caused by action of air and moisture alone under influences of sunlight.

Folding of heavy canvas, if it has been stiffened by freezing or waterproofing treatment, may weaken or crack the material.

Rules for Proper Care of Canvas Goods.

(1) Don't permit tents to remain in sunlight any more than necessary.

(2) Don't allow tent to remain up and exposed to the weather when not actually needed for occupancy.

(3) To fold: (a) Lay tent flat; (b) fold the ends square with the side walls; (c) fold the roof flat over the side walls; (d) fold again from the top edge toward bottom. Continue

to fold until the width of the fold is not greater than height of the side wall. Then roll or fold to desired shape. Folded this way, the roof, the most important part, is protected by the side wall and only the lower part of the side wall is exposed to wear and tear in storage or shipping.

(4) Never store canvas when wet unless to do so is absolutely unavoidable. Doing so will result in rotting of the canvas.

(5) Never store canvas on floor; hang it up, place on racks or on ventilated platform.

(6) In storing keep away from possible attack by rodents.

Tent rope.—Examine guy ropes and check condition before sending tents into the field. If metal or wooden slips on guy ropes are used, see to it before sending tents out that none are missing.

Operation, Maintenance, and General Care of Portable Power Pumps.

Only experienced operators should be entrusted with the operation, maintenance, and general care of pumper equipment. A reasonable working knowledge of the mechanics of pumps is essential to insure proper operation and maintenance of such equipment. Too often this is not the case and as a result, pumpers give faulty performance and in many instances are thereupon wrongfully condemned as no good.

No attempt is made to list the various requirements of each individual make and model of pumper; but a few facts regarding pumps which have general application in field practice have been recorded.

Routine field season tests.—Pumpers should be operated at least once each month during the field season as a check on serviceability and for training of operators. More frequent operation is desirable preferably once each week. Practice is necessary to maintain proficiency in operators and trained operators are essential to acceptable pumper performance.

Operation charts should be maintained for each pumper, recording the number of hours of operation, condition, repairs, and other data which might be required for future reference. When operation tests are made of any pumper, the pump should be tested for maximum pressure as noted on the operation chart. Failure to deliver the pressure is an indication of trouble in the unit. An accurate gage should be used for checking such performance as it is not very often that the gages with which portable pumps are equipped are within reasonable limits of accuracy. The vibration of the motor soon introduces serious error in the recording mechanism.

Vacuum test.—To determine the condition of a rotary-type pump, dry the pump by per-

mitting the unit to run with the suction line open for a few seconds. This will remove all water from the pump. Place the pump on its side and place a generous quantity of oil in the pump, working the pump by hand to make certain that oil reaches all parts of the water impellers; SAE 20 or other light oil should be used for this purpose. Secure a hose cap for the suction hose. This should be drilled and tapped to take a small vacuum gage. Check the suction-hose connections for tightness. Start the pump and operate it at a slow speed. As quickly as possible, attach the hose cap with the gage to the suction line and read the gage. Stop the pump as soon as possible because injury will result if the unit is permitted to run without load or water for even a few minutes. The short period of operation between adjusting the motor and attaching the hose cap will permit the excess oil to be thrown from the pump case and produce a normal seal which would result with a water-wet pump. Pumps which do not develop a vacuum of at least 7 inches should be considered as unserviceable and overhauled.

Storage.—For post-season storage the pump should be thoroughly dried and oiled. Such reconditioning as painting, replacement of packing, and minor repairs should be attended to before storage. Spark plugs should be removed and a small quantity of oil placed in the cylinders to lubricate the surfaces of the cylinder walls and pistons. Care should be exercised to see that all water is thoroughly drained from the cooling system of the motor if it is of the water-cooled type.

General.—Packing glands on pump shafts should be permitted to leak slightly. Such passage of water through the packing assists in lubricating the shaft and will result in cool operation of the bearing. Pump bearings should never be permitted to heat beyond a point where the bare hand cannot be held upon them comfortably.

Water jackets should never develop greater heat than can be withstood by the hand. However, normal heat should be maintained for proper operating efficiency; this can be obtained by regulating the overflow discharge until comfortably warm to the bare hand.

Motors should not be run at high speeds unless there is sufficient load to balance the power developed. Excessive vibration is set up when motors are operated without load, which is injurious to both engine and pump.

In two-cycle engines where the lubricating oil is mixed with the fuel, the engine should be stopped by closing the carburetor inlet valve. This permits the carburetor float chamber to empty and prevents the settling of the oil which is in suspension in the fuel; usually a cause of difficult starting when the engine is cold.

As a point of information, 1 inch of vacuum is approximately equal to $1\frac{1}{4}$ feet of draft. While the limitation of 7 inches of vacuum is set up for sea level, it should be maintained for the elevation at which the pumper is to operate. There is an appreciable loss of power as elevation is gained and since pumpers must work at reasonably high elevations, such checks are necessary to insure proper performance. A pumper which will not pull 7 inches of vacuum has so much slippage past the impellers that it will produce little effective pressure even with a 3-foot draft.

Remember that a pumper will, when new, draft a given maximum and develop a rated volume and pressure. Such figures are for sea-level conditions and the unit will not duplicate such performance at an elevation of 6,000 feet. Pumpers should not be required to draft more than 5 or 6 feet at the higher elevations if any volume or pressure is desired on the discharge side of the pump.

In order to insure better pumper performance provide adequate and correct lubrication and fuels. *Always* measure the oil when mixing with gas for two-cycle units. *Always* strain the fuel, whether clear or oil mixed, through a 200- to 250-mesh screened filter-type funnel or chamois skin when refueling any type of pumper. *Remember*, a portable power pumper is one of the most intricate pieces of equipment in use in fire-control work. Treat it properly and it will perform accordingly.

Care of Cotton-Jacketed, Rubber-Lined Hose— $1\frac{1}{2}$ -inch.

Hose of this type should not be exposed to the direct rays of the sun except when in use. Solar action on the rubber causes the liberation of free sulphuric acid which deteriorates the cotton in the jacket, weakening the hose.

After use, such hose should always be washed clean, thoroughly dried and stored in a dry place where there is some opportunity for the air to circulate around the hose. Storage in a damp place or when wet will usually result in mildew rot in the cotton fabric.

Hose of this type deteriorates much more quickly in dry warm climates than in cool moist areas. Warmth and low humidity lower the life of the rubber in the tube.

Standard Forest Service hose of the $1\frac{1}{2}$ -inch size has a minimum burst requirement of 600 pounds per square inch hydrostatic. Such hose secured from the Supply Depot at Oakland is tested to a hydrostatic pressure of 400 pounds before shipment to the field to test the hose couplings.

Care of Cotton-Jacketed, Rubber-Lined Hose—1-inch.

The same requirement for cleanliness and care in storage should be observed as with the $1\frac{1}{2}$ -inch hose.

The burst-test requirement for hose of this size is 400 pounds per square inch hydrostatic. Hose furnished by the Supply Depot at Oakland is tested to at least 250 pounds hydrostatic before shipment to the field.

Care of Linen Hose— $1\frac{1}{2}$ -inch.

Recent development in linen-hose weave and mildew-proof treatment permits the use of such hose under conditions which formerly were considered too severe for lightweight fabric hose. Improvement in the method of weave has produced a tight hose which seals rapidly once saturated and is no more rigid when wet than the loose, flexible weaves which have been furnished in the past. Positive sterilization of the fabric is now possible so that the loss from mildew is removed.

Linen hose is approximately one-fourth the bulk and one-half the weight of an equal footage of cotton-jacketed, rubber-lined hose. Costs are approximately equal.

While the mildew-proof treatment removes much of the danger of loss from deterioration, the same treatment in storage should be given linen hose as suggested for cotton-jacketed hose; storage in a cool, dry place after thoroughly cleaning and drying.

Linen hose is woven in an oval form. The edge of the hose is the loosest part of the fabric and is the weak point in the hose. Unfortunately, the edge receives the most abrasion in use and storage handling. It will be helpful in prolonging the life of the hose to roll it so that the edge of the fold is inside the roll. Weave characteristics will cause the hose to always find its natural position after use. If care is taken to so roll the hose that the apparent edge when the hose is drained is placed inside the roll, breakage of the yarn from chafing will be prevented.

Testing Fire Hose.

All hose purchased for Forest Service use should be tested to a reasonable static pressure before shipment to the field. The test pressure used should be approximately one-half that of the burst-pressure requirement of the hose. The reason for this requirement is that in shifting a water-loaded hose line in use, the entire weight of the loaded hose is taken by the near hose couplings. Considering the fact that a $1\frac{1}{2}$ -inch hose loaded with water weighs approximately 1 pound per foot of length, it is apparent that elongation stresses are produced far greater than the burst-test requirement of the hose. The only practicable method of determining if the couplings will withstand such use is to test each length of hose to a reasonable pressure. If the couplings hold without leakage or slippage, the hose should prove satisfactory in service.

At the beginning of the field season or immediately prior thereto, all old hose should be tested to the highest pressure it will be expected to withstand during the season. Cotton-jacketed, rubber-lined hose should be tested currently during the field season. Water is beneficial to the rubber tube, which, if permitted to remain dry over too long a period, soon deteriorates; this is also true of rubber-covered hose. Current testing of linen hose is neither desirable nor necessary.

Field testing may be accomplished with portable power pumps by attaching a siamese or other valve to the pump which will permit bleeding the line. Any length of hose may be connected to the pump. After operating the pump for a short time to expel all the air in the hose, the hose may be kinked at the far end or, if available, a shut-off nozzle attached to the discharge end and gradually shut off until the pump develops maximum pressure. At this point the bleeder valve at the pump should gradually be opened to relieve the strain on the pump. The only way to maintain pressure on the line is to keep the pump operating at normal speeds. The hose should be examined for leaks or other defect, such points marked with a crayon and cut out of the line when the test is completed. If centrifugal-type pumps are available, no bleeder valve is necessary to relieve the line load on the pump. Complete shut-off will not stop or injure the pump unless continued to a point

where the water churning in the pump develops a reasonably high heat.

Central warehouses or other depots where hose is received and stocked for field shipment should be equipped with small-capacity high-pressure pumps for testing hose. A number of such pumps are commercially available at reasonable cost.

High-Pressure Fire-Hose Tester. (R5-X.)

Region 5 has designed a simple type of tester for use in testing fire hose (fig. 3-14). The tester is constructed from a discarded truck transmission and half of a discarded Chevrolet motor block. It is operated by a 2-horsepower electric motor. The transmission permits choosing any one of several speeds so that pressure in the hose line can be built up at any desired rate. The tester, or pressure pump, is capable of developing up to 2,000 pounds per square inch hydrostatic pressure.

In constructing the pressure pump three cylinders of the Chevrolet block were used. The connecting rods of the three cylinders are attached to cross-head blocks which are turned to fit the cylinders. The pistons of the pump are attached to the lower end of the cross-head blocks. The pump cylinders are constructed of bronze stock with a conventional stuffing box. The inlet and outlet valves are bronze ball checks and are connected to the discharge lines with high-pressure copper tubing and compression fittings. The pump cylinders are

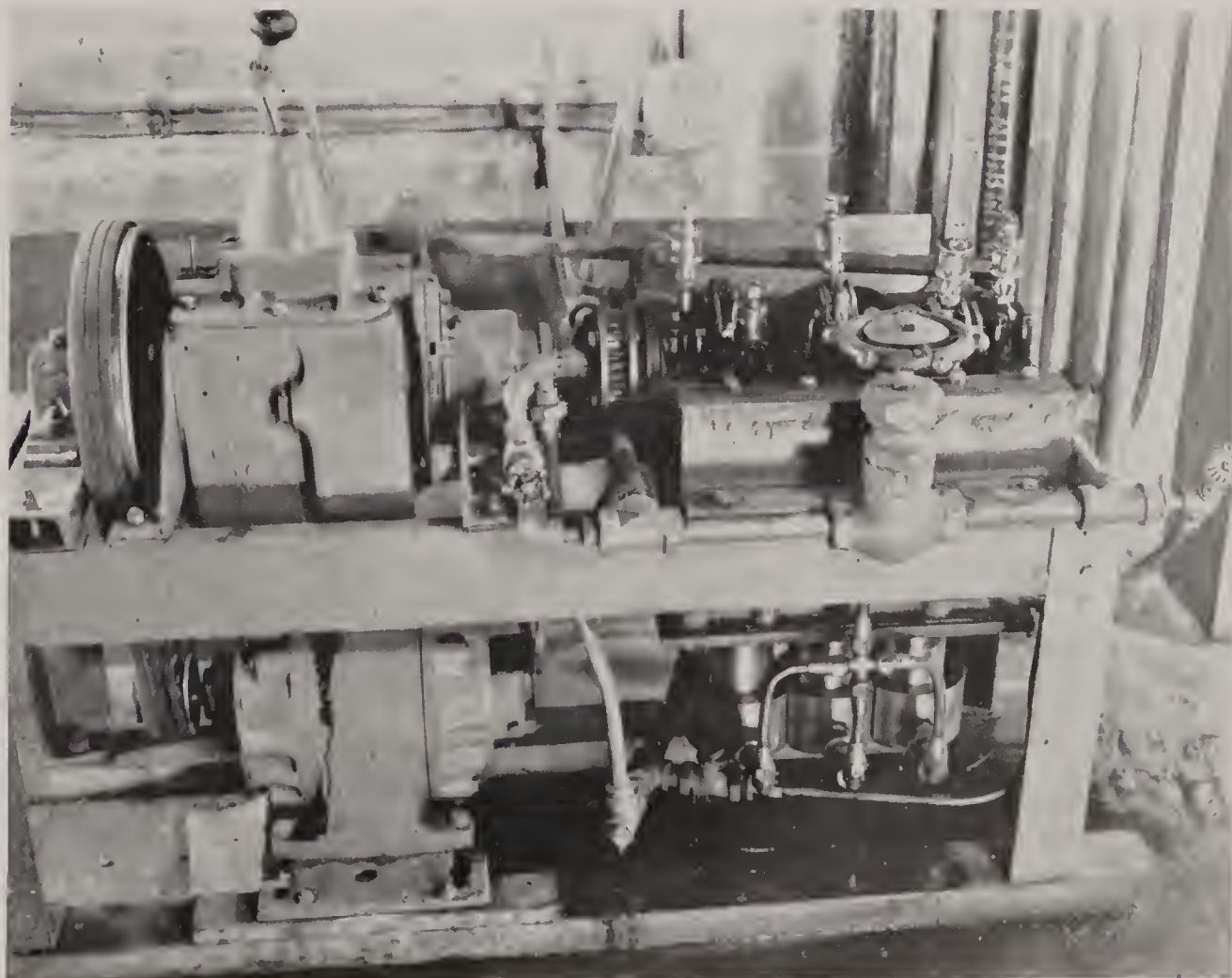


FIGURE 3-14. — Hydrostatic pressure-pump hose tester.

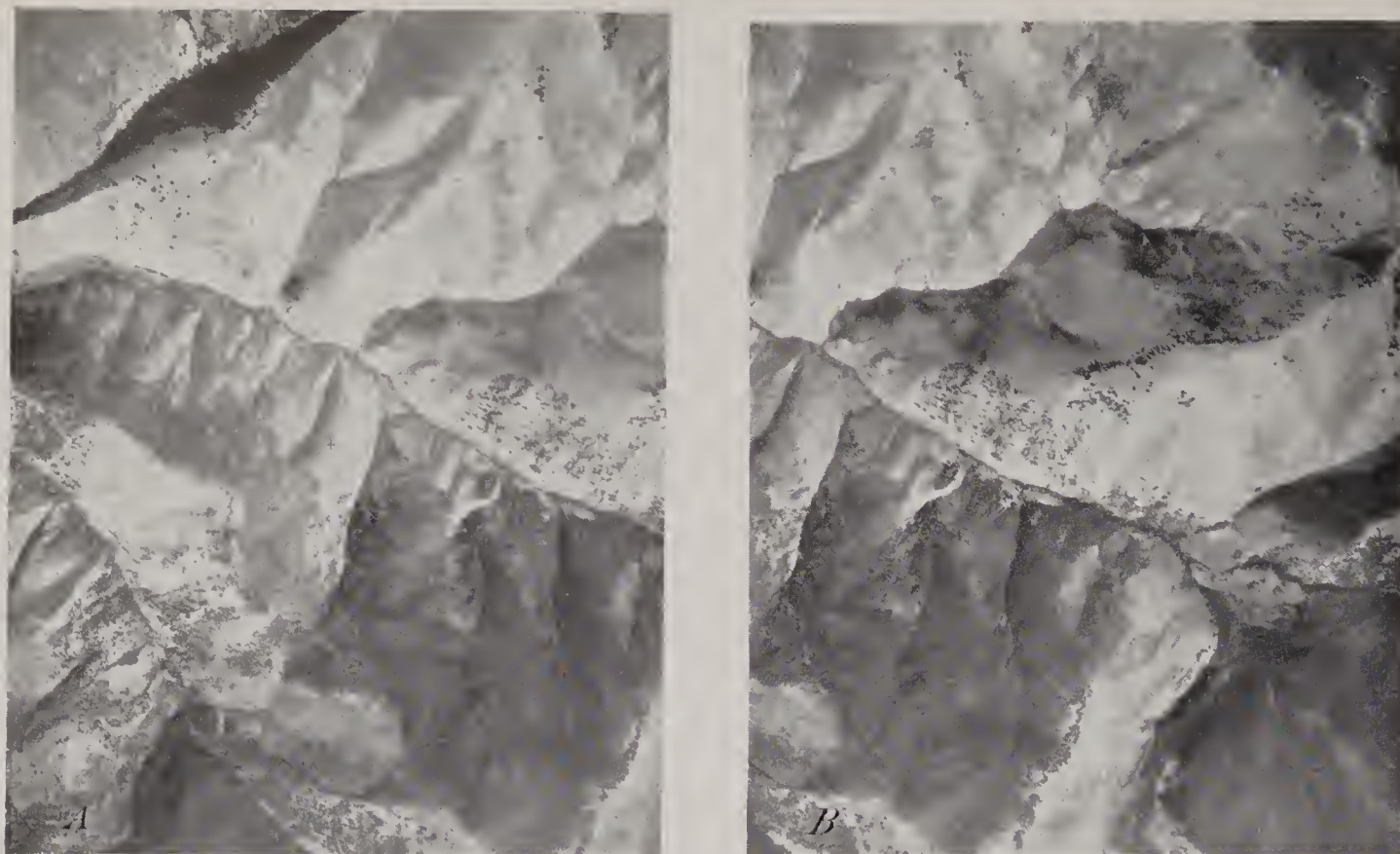


FIGURE 3-15.—Aerial photographs arranged in pairs for viewing through a stereoscope. These views are of timbered and open but mountainous country. The stereoscope brings these features out boldly in relief.

attached to the block by a $\frac{1}{2}$ -inch mill plate. Suitable gages, pressure relief, and regulating valves, etc., are installed. These, of course, can be varied to meet local requirements.

This particular type of pressure pump or hose tester can be constructed in almost any ordinarily well-equipped machine shop. Region 5 has prepared rough shop drawings for this type of tester. Further detailed infor-

mation should be requested direct from that Region.

This type of tester is particularly useful around central warehouses or central purchase units where there is a considerable amount of fire hose to be tested. By using various sizes of adapters any particular kind and size of hose made can be tested for hydrostatic pressure requirements.

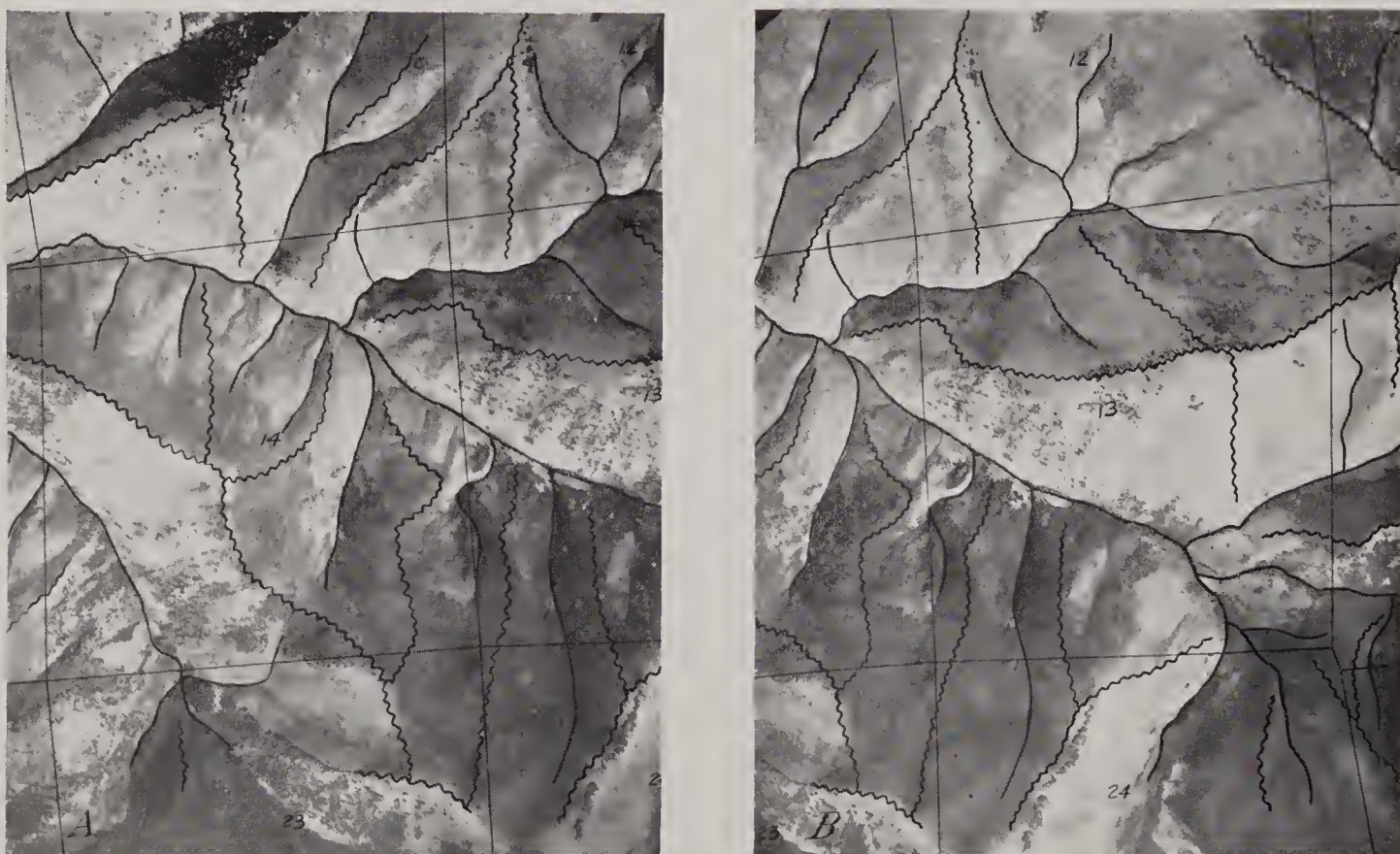


FIGURE 3-16.—Aerial photographs with topographic features, section lines, and numbers inked in. Note the overlap in the stereoscopic pair illustrated. This overlap is what causes the topographic and other features to stand out in relief when viewed in pairs through the stereoscope.

Aerial Photographic Mapping and Its Place in Fire Control. (R1-X.)

Aerial photographic mapping is now a permanent part of the scheme of fire control. It serves two major purposes: (1) making it possible to obtain exceptionally accurate maps of forested areas at a very low cost per acre and (2) providing a permanent photographic record of each area mapped. Aerial photographic surveys are unlike other photographic surveys in that there is no such thing as "blind" areas in the photographs secured in this manner. It is quite possible to see all of the various topographic and relief features within the area comprising each individual photograph.

After an exceptionally satisfactory base map has been compiled from aerial photographs they will have served just half of their real purpose and possibilities as indicated. Such features as ridges, mountain peaks, lookout positions, streams, lakes, type lines, and all other features which appear upon the ground, can be readily inked upon the various photographs, after which they form a permanent record readily available for viewing at any time in connection with fire-dispatching or actual fire-suppression work. When these photographs are viewed with the stereoscope, topographic, and drainage features appear in bold relief. Likewise, type lines stand out very clearly although it is not always possible to distinguish the exact type concerned. This latter constitutes no drawback to the use of the pictures whatever since, when viewed by a dispatcher or ranger who is familiar with the general locality concerned, sufficient detail is shown that he will readily know the various fuel and timber types concerned from his knowledge of the country coupled with the distinct lines shown by the photographs.

Figures 3-15 and 3-16 illustrate two stereoscopic pairs of photographs of the same area. One pair is made of two, plain, contact prints as they come from the negative. The topographic features have been inked in under the stereoscope upon the second pair and the section line projected thereon. Notice the irregularity within the section lines. This is due to distortion in the picture because of reducing irregular topography of varying elevations to a level plane. Also note the clear-cut manner in which type lines stand out without having been inked.

Aerial photographs, such as have just been described and illustrated, when viewed through the stereoscope make it quite possible for the dispatcher to select the best route for dispatching fire crews to a going fire within any given area. The photographs also furnish him with information as to steepness of slope and exposure, so that with what information he can obtain from the photographs in the way of

fuel-type lines together with his knowledge of the country, he is able to tell quite accurately the probable type of fuel in which the fire is burning.

Region 1 has designed a special fire-dispatcher's desk which will be explained more fully hereinafter and for which detailed specifications have been prepared. Anyone interested in either aerial photographic survey work or the special fire-dispatcher's desk should request further detailed information or specifications direct from Region 1.

In addition to the stereoscope feature and the indexed file scheme for aerial photographs, the desk embraces a scheme for using lighted seen-area silhouettes and smoke-chaser travel-time silhouettes. With the aid of these devices the dispatcher is enabled to determine just which areas are "blind" from detection with the detection force which he has on duty. Also, he is able to determine just which lookout is able to see any given area. The smoke-chaser silhouettes provide him with information as to how quickly any given area can be reached and from which station it can be reached in the shortest time.

A brief description of the method of taking aerial photographs and of compiling base maps therefrom follows; also an illustrated description of the fire-dispatcher's desk:

Aerial Photographic Surveying.

All aerial photographs used for map-making purposes in Region 1 are taken with a Fairchild's K-3 single lens vertical camera equipped with intervalometer and an extra magazine as illustrated by figure 3-17.

Nonshrinkable supersensitive panchromatic film is used. It comes in rolls 10 inches by 75 feet and produces about 110 7½- by 9½-inch contact prints per roll.

Photographs are taken from an elevation of 17,000 feet above sea level or 12,000 feet above the average elevation of the ground. They overlap 55 to 60 percent along the line of flight with an average lateral overlap of 30 percent between flight lines. Correction for "crab" and tilt is made at time of exposure.

Control consisting of triangulation stations, plane-table stations, and General Land Office surveys is platted on a 2-inch base and used to govern map compilation.

Topography culture and types (fig. 3-23) are inked in on control prints (upon which all control stations have been identified) under a stereoscope. The radial method supplemented by projectors, produces a map on a scale of 2 inches to 1 mile, the information from which finds its way into ½- and 1-inch administrative maps, which are used for all phases of fire work.

Section lines and section numbers are placed on mounted prints by using a tracing of the



FIGURE 3-17.—Mounting of aerial camera with vertical view finder and intervalometer.

final map and a special projector. The mounted prints are filed in compartments by strip lines in drawers of the fire-dispatcher's desk (fig. 3-26). After a fire is reported, its exact location can be viewed in relief under the stereoscope by consulting the line-index map. It takes 30 seconds on an average from the time the line-index map is consulted until pictures are placed beneath the stereoscope and oriented to position for viewing.

The fire-dispatchers' desk with lighted stereoscope, mounted pictures and maps made from them, line-index maps, seen-area and smoke-chaser travel silhouettes, fuel-type maps, organization maps, weather reports, danger meters and other gadgets, including radio sets and telephone switchboard, provides the fire dispatcher with

a new tool capable of rapid manipulation and adequately and conveniently equipped—an invaluable asset for fire use (figs. 3-18, 3-19).

Panoramic Photography in Fire Control. (R6-X and R6-P.)

The graduated panoramic photograph provides a permanent and accurately oriented view from point at which taken and can be used to great advantage in many phases of forest-fire-protection work, mapping, reconnaissances, etc.

The pictures are obtained with a special camera, or photo-recording transit, which is similar in many respects to a transit (fig. 3-20). It has a leveling head, full azimuth circle and vernier, an open-sight alidade, a high-grade magnetic needle, a 1-minute spirit level, and a Smith solar attachment which enables the operator to obtain a true meridian and precise orientation from any set-up without recourse to other instruments. All interior scales and adjustments are accurate to within 1' or 2' of arc.

In operation the instrument is set up, orientated, and adjusted in the same manner as a transit. An exposure is then made. The resulting negative, which covers an arc of 126°, will be precisely



FIGURE 3-18.—This view shows (1) compartment A with drop door and atlas binders and other maps filed on shelves, and (2) drawer C, slightly opened but not far enough to reach switch and turn on light. (Use precaution against leaving lights on and running down battery or running up electric bill when not in use. Desk is equipped to use either commercial current or battery power.)



FIGURE 3-19.—This print shows (1) drawer C pulled out and lumeline lights turned on, and (2) drawer H with compartments and mounted aerial photographs filed by strips or lines (note extra room at back of drawer for filing correspondence or other material, if desired, until additional photographs are obtained. For smaller ranger districts there will always be some extra room).

graduated and numbered in azimuth along its top margin. On the two ends of the exposure there are level line markers and a vertical-angle scale, in degrees (refer to figs. 3-21 and 3-22).

As soon as the negative is developed a level line is scratched across its face connecting the markers just mentioned. If made on the emulsion side, it prints black; if on the glossy side, it prints white. The name of the lookout, or station, is then inked in on the lower margin and the names of peaks, ridges, and drainages may be lettered on, if desired. Naturally all of these markings are reproduced on all prints.

Previous to 1935 photos were taken with type 2 aero panchromatic films with red filter and very good pictures were obtained under clear atmospheric conditions. It was then found that a type D infrared film and a dark-red filter obtained unusually clear photos under hazy conditions. More recent experiments indicate that each set-up is an individual

study requiring the technique of the operator to determine which type of film will obtain the best results. The angle of topographic features and direction of light are of paramount importance.

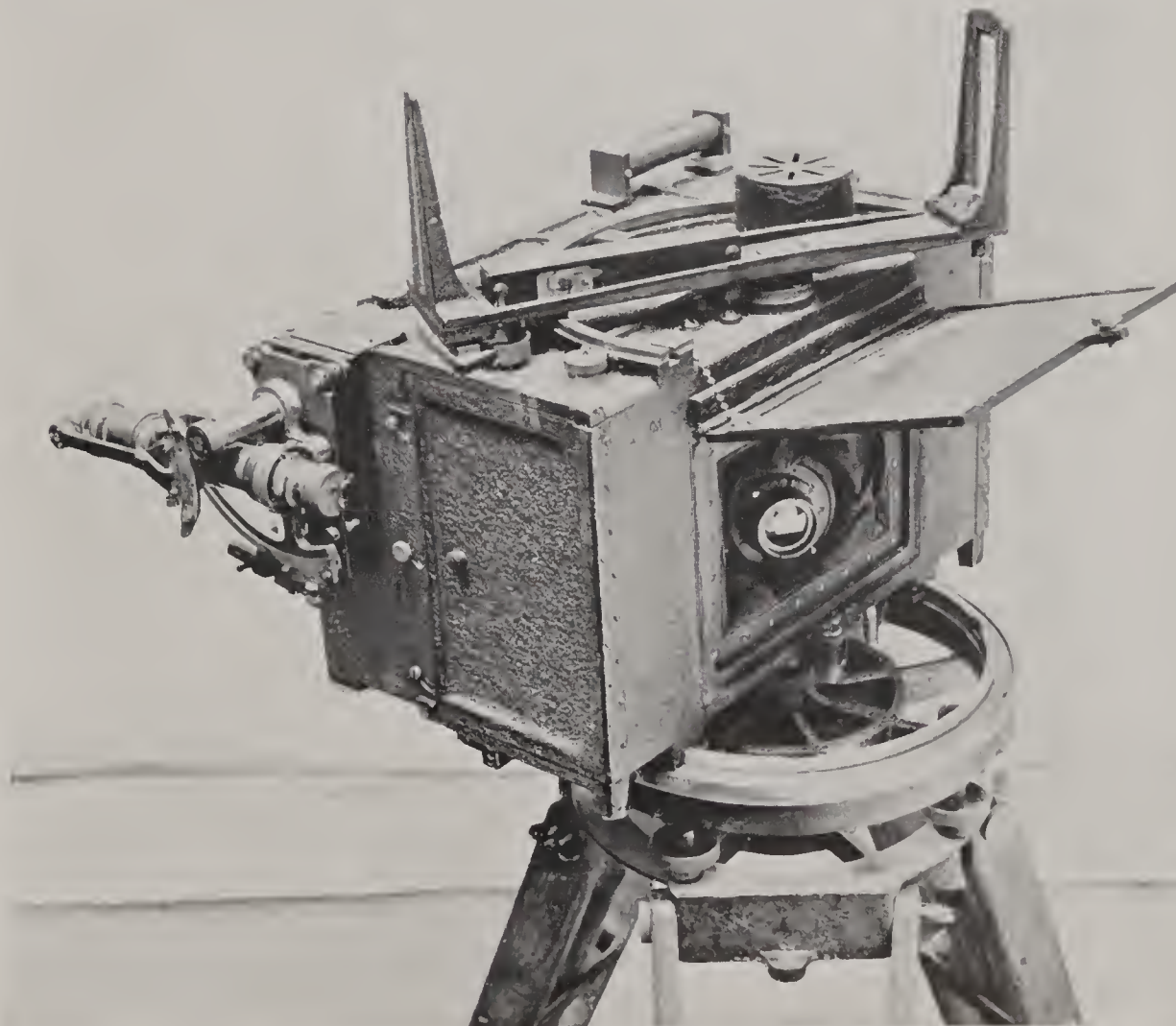


FIGURE 3-20.—Panoramic photo survey camera.

Given a photograph as described and a movable vertical-angle scale for defining line of sight and scaling off vertical angles, anyone can determine in a few seconds and to accuracy of a needle point the exact location of any fire or other object that the lookout reports by azimuth and vertical angle, or for mapping purposes he can simply reverse the procedure and obtain directly from the picture the true azimuth and vertical angle to any object. A comparison of horizontal and vertical angles obtained from the pictures with transit readings on the same objects will show a maximum discrepancy of not more than 2' or 3'. (The editor doubts the possibility of obtaining such accuracy, but

grants that photos are entirely accurate for all practical purposes.)

In the application of this method a complete set of photos is secured from each lookout station (three pictures to each panorama). One or more sets are retained for administrative and mapping purposes. Then all members of the protective organization, including rangers, dispatchers, and firemen, are supplied with such pictures or sectors as cover territory lying within their protective units.

When a lookout reports a fire, all men concerned are able to spot its location on the photographs. They see photographically the exact spot. A small magnifying glass brings out a remarkable amount of

detail and the location can be seen in reference to ridge tops, lateral spurs, draws, rockslides, and other important landmarks. Also, they can actually see the steepness of slope, aspect, and cover conditions, within certain limited distances from the point where photos were taken, all vital factors in governing the probable rate of spread and consequently the number of men needed to insure control.

It might be said that this is, in effect, applying television to protection work. Actually it is better, for the photos have been taken during clear weather so that frequently the location can be seen much better on the pictures than from the lookout. In case of fires sighted at night,



FIGURE 3-21.—Photo taken with panoramic photo survey camera and infrared film. Grassland and light-colored objects have the appearance of snow when photographed with infrared film.

these pictures in effect turn night into day.

The prints are ideal for assisting new lookouts to learn their country. Visibility maps can be prepared from the pictures at any convenient time as readily as they could be made from topographic maps.

Other uses in connection with protection work are making map corrections and checking fire-finder orientations, illustrating special hazards, and as irrefutable evidence in damage suits. Information may be obtained for grazing studies, and timber, road, and geodetic surveys.

Region 6 has been responsible to a great extent for the pioneering and development of this phase of fire-control work within the Forest Service. The region

should be called upon by anyone desiring further detailed information. Forest Service units desiring to purchase panoramic photo survey cameras should do so through Region 6 where specifications are available.

Catchment Basins and Storage Tanks for Collecting Rain Water.

The purpose of a catchment basin and storage tank is to provide a source of water for use in fire suppression on the forests where water supplies for tank trucks present a problem. Several such units have been constructed on the southern California forests in the past 2 years and are proving highly satisfactory. The area of catchment basin required for any given volume of water desired is com-

puted from an estimate of the normal rainfall in the vicinity.

The typical installation illustrated includes a 1,600 - square - foot catchment basin, sediment trap, and a 7,500-gallon reinforced tank provided with a fire hydrant on the outlet pipe. Installations using all concrete, corrugated galvanized-iron catchment and tank, and premix oiled catchments with concrete and metal tanks have been constructed (figs. 3-23 and 3-24). On the basis of durability and low maintenance costs, only concrete systems are recommended. The average cost for an all-concrete system based on several already constructed is approximately \$1,400. The average cost of materials delivered to the site is approximately \$450.

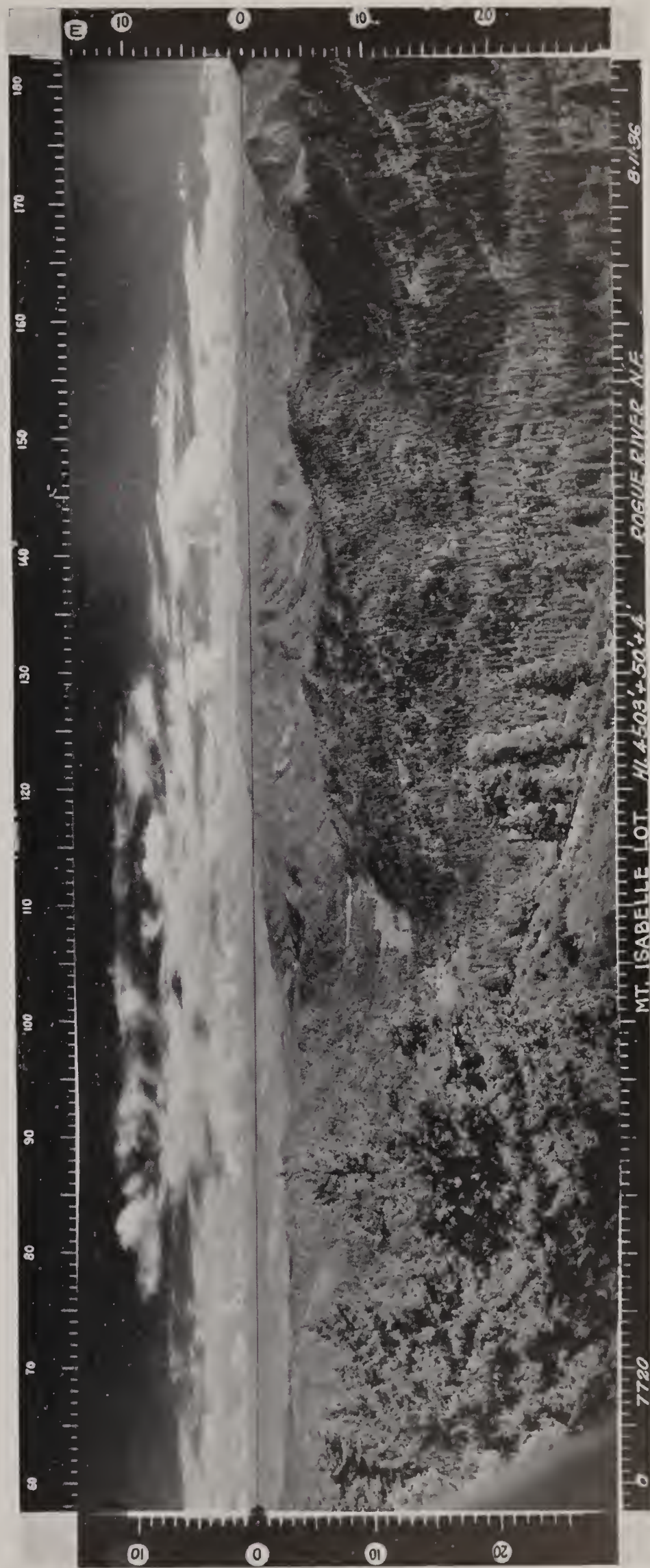


FIGURE 3-22.—Photo taken with panoramic photo survey camera. Note horizontal and vertical graduations, as well as level or zero vertical angle line.



FIGURE 3-23.—Concrete catchment basin.



FIGURE 3-24.—Concrete storage tank below catchment basin.

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SPECIFICATION NUMBERING INDEX
PURCHASING AND INFORMATIONAL REFERENCES

SPECIFICATION NUMBERING INDEX

PURCHASING AND INFORMATIONAL REFERENCES

NOTE.—When the letters MSF appear as a prefix to the master file index number of an item, it signifies that the specification for the type of article described has been adopted as standard for the Forest Service. Where the letter S is affixed to the index number it denotes that the entire specification for the particular item concerned is contained in the handbook write-up. When such a reference mark as R1-X, R3-X, or R7-X appears in lieu of an index number, it signifies that requests for more detailed information or specifications should be submitted direct to the regional forester of the Region indicated by the central number. In cases involving outside agencies, the name and address will appear.

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